Agricultural Research Service

United States Department of Agriculture

Water Quality and Ecological Processes Research Unit

National Sedimentation Laboratory

Oxford, Mississippi 38655

Preliminary Report

Preliminary Assessment of the Water Quality, Biological Habitat, and Biotic Communities of the Yalobusha River Watershed

Prepared By:

C.M. Cooper, M.T. Moore, W.B. Gillespie, Jr., S. Testa III, F.D. Shields, Jr., and P.C. Smiley, Jr.

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**Water Quality/Ecological Processes Research Unit
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Oxford, Mississippi**

**In cooperation with:
U.S. Army Corps of Engineers
Demonstration Erosion Control Project
Vicksburg District
Vicksburg, Mississippi**

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Debris jam on Yalobusha River west of Calhoun City, Mississippi

Introduction

The Yalobusha River Basin research project represents a comprehensive and integrated approach to monitoring, evaluating, and controlling sediment and water from upland areas into and through the watershed channel system ending in the Grenada Lake flood control reservoir. This project is part of the cooperative Demonstration Erosion Control (DEC) project involving the U.S. Army Corps of Engineers (COE), the USDA Natural Resources Conservation Service (NRCS), and the USDA – Agricultural Research Service/National Sedimentation Laboratory (ARS/NSL). The overall project includes monitoring and evaluation of geomorphic characteristics, sediment and runoff related water quality, and ecological components of the system. Using this approach, the interrelationship between sediment and water delivery from upland areas to the channel system, and sediment demand by channel flow resulting in concomitant changes in the channel system and channel evolution are being investigated. Concurrently with hydrologic and geomorphic measurements, movement of agricultural chemicals used in past and present cropping management is being monitored to determine their possible impact on the system. Baseline information will allow effects of channel bank and streambed stabilization and stream restoration measures (as dictated by local geomorphic and hydraulic conditions) on stream hydrology, morphology, water quality and ecology to be assessed.

This integrated watershed erosion control and water quality and ecology research program in upland areas of the Yalobusha River Basin covers essential environmental research needs and is providing information on watershed conditions in the basin upstream of Grenada Lake. An immediate need for watershed evaluation has been emphasized by the effects of an extensive debris dam completely filling the river channel west of Calhoun City, MS. Over one mile in length and enlarging, the debris dam has caused widespread flooding in upstream and adjacent farmland and residences. A recent geomorphological survey of the watershed also revealed the presence of numerous head-cutting knickpoints in the stream channels that are resulting in stream degradation, stream bank failure, gully formation, and bridge destabilization (Simon 1998). These processes are causing system-wide damage to the landscape infrastructure. The specific goals of the water quality and ecology research are to monitor and assess surface water and sediment quality and contaminant parameters at main stream and tributary sites, evaluate main stream and tributary fish and invertebrate communities and habitat over time (and in a pre- and post stabilization construction setting), and assess lake-wide variability of basic water quality parameters by monitoring inflow and outflow of Grenada Lake.

Materials and Methods

Geomorphic Evaluation

To determine channel processes and forms, helicopter evaluations and direct field sampling were performed. Geomorphic analyses were completed by Dr. Andrew Simon and associates in a separate cooperative effort between the ARS/NSL and the COE, Vicksburg District (Simon et al. unpublished data). Sites were selected based on ease of aerial identification; thus most sites were located at bridges, although some were at confluences and sharp bends throughout the system. All geomorphic field evaluations occurred approximately 6-20 channel widths upstream from bridges (Simon, 1998). During geomorphic evaluations of approximately 190 sites, stages of channel evolution and bed and bank (i.e. channel conditions, bed material conditions, knickpoints and knickzones, shear strength, and channel bank stability) were recorded. Of these 190 sites, 21 were selected for geotechnical testing of bank material (Simon, 1998).

One of the principle objectives of the Yalobusha Watershed project is reduction of flood stages in the vicinity of Calhoun City by modifying the existing downstream channel plug (i.e. natural debris jam). Regardless of how these modifications are accomplished, they will likely produce noticeable changes in aquatic habitat quality and quantity in the large and complex riverine ecosystem. For example, the base-flow water depth in the Yalobusha River between Calhoun City and the debris blockage is currently 2-4 m. Base flow will probably decline sharply after removing the block or opening a new channel, possibly altering upstream habitat and fauna.

To measure changes in water depth and velocity resulting from the debris jam, an echosounder coupled with a differential global positioning system (DGPS) and an acoustic doppler current profiler was used. During June and July 1997, contour maps of the channel bottom in four reaches upstream and four reaches downstream of the Yalobusha River debris/sediment jam were produced. These experimental reaches varied in length from 500 to 700 m. A total of 2.4 km was mapped below the jam and 2.7 km above the jam. Detailed water velocity measurements were made during January-March 1998 for channel cross sections above and below the sediment/debris jam. A series of qualitative observations including sinuosity, distance between top banks, emergent and submerged woody debris, and variations in water depth accompanied quantitative observations.

Water Quality Evaluation

Twelve sites located within the Yalobusha River basin above Grenada Lake, and one site located at the outflow of Grenada Lake (Figure 1), were selected for routine water quality sample collection and measurement of selected water quality parameters. Aqueous samples were collected every two weeks from each site. Sampling began in December 1996 and is continuing.

At each watershed site, a 4-L plastic container was lowered from the bridge to collect water for immediate determination of dissolved oxygen, temperature, pH, and conductivity. Dissolved oxygen and temperature were

measured using a YSI Model 57 oxygen meter. Conductivity was measured using a YSI Model 33 conductivity meter, and pH was measured using an Orion Model SA250 pH meter. At each site, water surface elevation was measured as the distance (m) from the top of the bridge to the surface of the water with a stainless steel depth chain. After collecting field measurements, a sub-sample of collected water was transferred to a 1-L Nalgene cubitainer, placed on ice, and transported to the University of Mississippi for laboratory analyses.

Upon return to the laboratory, solids (total, dissolved, and suspended), total orthophosphorous, filtered orthophosphorous, nitrate, ammonia, chlorophyll (*a*, *b*, *c*, and total), fecal coliform, and enterococci were measured following APHA (1992) guidelines. Solids referred to matter suspended or dissolved in water, whose origin may have been natural (e.g., erosion from uplands, lateral movement of channels into streambanks, and headcutting) or anthropogenic (e.g., agriculture, forestry, mining, and urban development). Total solids included "total suspended solids", the portion of solids retained by a 0.45 μm Metricel filter, and "total dissolved solids", the portion that passed through the filter. Total solids were measured by evaporating a well-mixed 100 mL aqueous sample in a Pyrex glass evaporating dish to constant weight at 103-105 $^{\circ}$C in a laboratory drying oven (Section 2540 B., *Standard Methods for the Examination of Water and Wastewater,* 18th Ed., APHA, 1992). Evaporating dishes were weighed to the nearest 0.1 mg prior to addition of sample and after drying with a Denver Instruments analytical balance. Total dissolved solids were determined by filtering a well-mixed sample of water through a 0.45 μm Metricel filter, then drying a 100 ml sub-sample to constant weight at 180 $^{\circ}$C as described above (Section 2540 C. in *Standard Methods,* 18th Ed., APHA, 1992). Suspended solids were calculated by taking the difference between dissolved and total solid concentrations for each sample.

Phosphorus is a nutrient essential for proper growth of all living organisms and occurs in surface water almost solely as phosphates (e.g., orthophosphates, condensed phosphates, and organically bound phosphates). Phosphates occur in solution, sorbed to particulate matter or detritus, or in the bodies of living organisms. Because phosphorus is a primary plant nutrient, excess stream phosphates are largely associated with fertilizers and runoff from agricultural lands. For water quality evaluations, total phosphorus was measured by acid hydrolysis (Persulfate Digestion Method, Section 4500-P B., APHA, 1992) followed by direct colorimetry (Ascorbic Acid Method, Section 4500-P E., APHA, 1992). Dissolved reactive phosphorus was determined by the Ascorbic Acid Method [Section 4500-P E., *Standard Methods,* 18th Ed.] (APHA, 1992) following filtration of the sample through a 0.45 μm filter.

Like phosphorus, nitrate is an essential nutrient for many photosynthetic autotrophs, but concentrations >30 mg/L may occur in surface waters from agricultural runoff (fertilizers) and nitrifying biological treatment facilities. Nitrate was measured by the Automated Cadmium Reduction Method (Section 4500-NO_3^- F., APHA, 1992), following filtration through a 0.45 μm filter. Ammonia is generally the most reduced form of nitrogen found in surface waters, and it binds readily to clay and other sediment particles. Primary sources of ammonia in

surface waters include deamination of organic nitrogen-containing compounds and hydrolysis of urea. After filtration of the sample, ammonia was determined by the Phenate Method (Section 4500-NH_3 D., APHA, 1992).

Concentrations of photosynthetic pigments are useful for determining phytoplankton biomass, and to some extent, may give an indication of the nutrient loading in a particular system. Chlorophyll *a*, *b*, and *c* concentrations in filtered water samples (0.45 μm filter) were determined spectrophotometrically following the trichromatic method (Section 10200 H., APHA, 1992). Total chlorophyll was determined by summing the *a*, *b*, and *c* component concentrations.

The coliform bacteria group consists of several aerobic and facultative anaerobic, gram-negative, spore-forming, rod-shaped genera of bacteria that ferment lactose with resultant gas and acid formation within 48 h at 35°C. Presence of these bacteria in surface waters may indicate human and domestic livestock waste inputs from upstream and adjacent areas. Fecal coliform bacteria in water samples were determined by the membrane filter technique (Section 9222, APHA, 1992). The enterococcus bacterial group is a subgroup of fecal Streptococci that differ from other streptococci by their ability to grow in 6.5% sodium chloride at pH 9.6 at 10°C and 45°C. Like the coliform group, the enterococci portion of the fecal streptococcus group is a valuable indicator of fecal contamination in surface waters. Fecal enterococci were determined by the membrane filter technique (Section 9230 C., APHA, 1992).

Pesticide Evaluation

Water and sediments were collected from 24 sites within the Upper Yalobusha Watershed (Figure 1) for analysis of selected pesticides during late fall of years 1996 and 1997. Stream water grab samples were collected at each site and poured immediately into 1-L clean (acetone/hexane rinsed), glass sampling jars with Teflon lined lids. Samples were labeled for site verification, stored in coolers on ice, then returned to the laboratory and stored at 4°C until analyzed.

Sediments were concurrently collected either by use of a 2 inch diameter stainless steel hand corer at wadeable sites, lowering an Eckman Dredge from the bridge at deeper sites, or a small shovel (e.g. at sites with a hardened substrate). Samples were collected from approximately the top 10 centimeters of hydrosoil. After collection, sediments were placed in 1-L clean glass jars with Teflon lids. These were labeled, stored on ice, returned to the laboratory, and placed in a refrigerator at 4°C until analyzed.

Fish tissue was also collected for pesticide analysis at sites in the main Yalobusha channel above and below the debris jam between Calhoun City and Grenada Lake. Fish were collected by electro-shocking and hoop-netting and returned to the laboratory where individual sections were prepared for pesticide analyses. Over 40 pesticides were analyzed for each component sampled (i.e., water, sediment, and fish) (Tables 1 and 2).

Fish Evaluation

Fish were collected from 33 sites within the Upper Yalobusha River (located upstream of Grenada Lake) (Figure 2). Sites were classified as headwater sites (9% of total sites), riverine sites (24% of total), and tributary sites (67% of total) based on location within the watershed. Headwater sites were wadeable and located within the headwaters of the main channel of the Yalobusha. All riverine sites were unwadeable, four of which were located within the main channel upstream of the debris jam, and four downstream of the debris jam. Tributary sites were wadeable sites not located within the main channel of the river. Fish collection was conducted from late January to May 1997. Collections of fish from additional Yalobusha watershed sites are currently underway; however, these will not be presented in this report. Fish were collected from headwater and tributary sites using a backpack electroshocker (Coffelt Mfg., Inc., Flagstaff AZ, Model BP-4) and were reported as fish per unit effort. Fish from riverine sites were collected with boat electroshocking (Coffelt Model VVP-2C with stainless steel sphere anode) and hoopnetting. All fish were identified using Etnier and Starnes (1993) and Ross and Brenneman (1991). Total number of individuals, mean species richness, mean number of captures, and previously unreported species for the watershed were determined.

During fish collection, three distinct types of habitat data were collected. The first consisted of one-time measurements of contributing watershed description, stream order, distance to confluence, precise location of reach, channel sinuosity, and photographs. Second, verbal descriptions or visual estimates of structure presence, woody debris, bank vegetation, length of eroding bank and mode(s) of failure, and bank height were collected. Third, stream width, water depth, bed type and velocity were recorded. Relationships between fish parameters and these data are still being analyzed.

Invertebrate Evaluation

Preliminary invertebrate collections were made at 9 sites located in the Yalobusha River Basin above Grenada Lake (Figure 2) to determine a baseline for later comparison, and to determine any modifications of the sampling and habitat measurement protocols that might be needed based on ecoregion requirements. All sites were wadeable and were sampled in late February of 1998. Sampling of invertebrates followed the most recent Environmental Protection Agency (EPA) Rapid Bio-assessment Protocol (RBP). Specific methods used for sampling were outlined in Section 7.2 – Multi-habitat Approach: D-Frame Dip Net Method (Barbour *et al.*, 1997). The protocol calls for collection of 20 sub-samples within each sampling site proportionately distributed among available habitat types. Sub-samples were 0.5 m sweeps of individual micro-habitat areas using a standard D-frame aquatic net. Sampling sites were 50 m stream reaches, usually at previous fish collection sites. Material collected within each site was composited as indicated in the RBP protocol, placed in 1-L labeled Nalgene containers with 95% ethanol, and returned to the laboratory for identification and enumeration of invertebrates.

As with any assessment of "ecological integrity" of a system, an evaluation of the habitat quality is critical. Habitat type may incorporate aspects of physical, chemical, and biological interactions. Habitat characterization in conjunction with invertebrate sampling also followed EPA's RBP procedures, which relate to the quality of instream and riparian habitat that influences structure and function of the stream community (Section 7.2). In this case, physical characterization includes documentation of general land use, stream origin and type, riparian vegetation features, and stream measurements such as width, depth, flow and substrate. The RBP qualitative habitat assessment, defined as evaluation of the structure of the physical habitat influencing the quality of water and condition of resident biota, was also performed. Metric measures included evaluation of the variety and quality of the substrate, channel morphology, bank structure, and riparian vegetation. All collections generally followed recommendations of the US EPA Rapid Bioassessment Protocol although some parameters were slightly modified or added to fit the requirements and objectives of this particular project.

Results

Geomorphic Evaluations

Geomorphic evaluations of the Yalobusha watershed occurred during the spring and summer of 1997. Channel conditions, bed material conditions, knickpoints and knickzones, shear strength, and channel bank stability were evaluated and previously reported (Simon 1998). Additional collections of geomorphic data are ongoing by Dr. Simon and co-workers at the National Sedimentation Laboratory and will be presented appropriately.

The area below the debris jam is quite sinuous and although mapping was confined to the main channel, water covered the floodplain on both sides of the channel for an indeterminate distance. Top bank was under water, but its approximate location was clearly marked by a dense growth of woody vegetation that bordered the channel on both banks. Woody debris was common, and there were numerous cypress trees. Submerged woody debris was often observed with the echosounder. Variation in depth laterally and longitudinally was minimal. Above the debris jam, the river was straight, trapezoidal, and wide. Sand waves and submerged woody debris were also observed with the echosounder profile.

Echosounder and DGPS data were used to generate contour maps of each reach (Figure 3). Selected channel cross sections were also plotted (Figure 4). The contour surfaces were used to compute water volume and surface area for selected water surface elevations in each reach. In general, the data confirmed the aforementioned visual observations. Mean water depth was 3.5 m below and 1.7 m above the jam. Greater channel sinuosity values downstream of the jam consequently increased area and volume of downstream habitat. Water volume and surface area corresponding to various elevations were computed using river bed contour maps. These computations were then used to estimate the impact of the project on the quantity of channel aquatic habitat. If baseflow stages in reaches upstream of the jam are reduced by plug removal or flow diversion into a new channel, the volume and area of channel habitat (water)

populations, and warrant further study. Additionally, identification of invertebrates from this watershed revealed the presence of several species that are typical for the geomorphic region, but have not previously been collected in other DEC watersheds (Table 27-35). Timely measures to protect this watershed from further degradation appear necessary to prevent loss of those species from the area. A more complete evaluation of the Yalobusha River system invertebrates will be possible following completion of current research activities.

Summary

The Yalobusha River Watershed upstream of Grenada Reservoir became a Demonstration Erosion Control (DEC) watershed project as a result of 1997 Congressional legislation. The Agricultural Research Service is conducting baseline studies in watershed water quality and environmental conditions. This report presents preliminary data in physical and chemical water quality, pesticides and metals, invertebrates, fish and habitat.

Basic contour maps of river reaches above and below a major debris dam have been generated. Complete removal of the plug would result in major reductions in channel habitat volume and area. Discharge and fish species describe a low velocity, riverine lake habitat upstream of the jam and a riverine environment downstream of the debris jam.

Phosphorus, nitrogen and suspended solid concentrations were not excessive. Peaks followed rainfall/runoff events. Dissolved oxygen followed seasonal temperature trends with few concentrations low enough for concern. pH was slightly acidic, typical of water draining from acid soil. Coliforms were typical of natural waters, reflecting seasonal concentration of wildlife near water. Several current use and residual pesticides were found in water and fish tissue in low concentrations as would be expected in a mixed cover agricultural watershed. Habitat varied from stable to disturbed. Preliminary data from invertebrates and fish also varied from site to site but showed that they should serve as good indicators of watershed condition and reflect watershed improvements from DEC.

The large debris plug west of Calhoun City, Mississippi has altered habitat upstream. A stream contour map, cross-sectional and discharge information above and below the debris plug are available for decision-making purposes.

Preliminary findings revealed the Yalobusha River and tributaries to have fair water quality. Habitat varied with stream stability and drainage history. Improvement in water quality and habitat are achievable goals.

References

APHA (American Public Health Association). 1992. Standard Methods for the Examination of Water and Wastewater. 18th Edition. Greenberg, A.E., Clesceri, L.S., and Eaton, A.D., Eds. APHA, Washington, D.C.

will likely be reduced by 90 and 67%, respectively. Such base flow level change may also influence degradative upstream channel incision processes.

Results from acoustic-doppler measurements (Figure 5) are heavily influenced by greater discharge (six times) for the reach upstream from the jam (January 29, 1998) than for the reach downstream (February 23, 1998) during data collection. Nevertheless, data emphasize the low velocity, depositional nature of upstream reaches, and the nearly lentic habitat they provide. In contrast, downstream reaches are more riverine, with strong secondary circulation typical of a meandering channel.

Water Quality Evaluation

Mean water parameters were determined for each site during the period of December 1996 to December 1997 (Tables 3-15). Data for water parameters measured at each site on each sampling occasion were also plotted over time to describe seasonal trends throughout the year (Figures 6 through 19).

Pesticide Evaluation

Analyses were completed for 42 individual contaminants for both water and sediment samples collected from the Yalobusha River basin. Of these, 19 were detected in water samples and 23 in sediment samples (Table 16 and 17). Of the 41 contaminants sought by analysis in fish tissues, only 21 were detected (Table 18). Data are inconclusive at this point. Additional seasonal samples are planned.

Fish Evaluation

Table 19 represents the summary of fish collecting efforts from the 33 sites in the Yalobusha watershed. A total of 61 species of fish were collected, representing 17 families and a total of 3,971 individuals (Table 20). Twenty-eight of the 61 collected species had not been previously reported for this portion of the Upper Yalobusha River Watershed (Table 21). Total species richness, mean species richness, total number of captures, and mean number of captures were not significantly different among headwater, riverine, and tributary sites (Table 22). Table 23 represents the relative abundance of individual fish species (species composition) for each site category. Species richness and mean number of captures were not significantly different between riverine sites above and below the debris jam (Table 24). Table 25 represents the species composition of riverine sites located above and below the debris jam.

Invertebrate Evaluation

Characterizations of habitat at the nine sample sites are in Table 26. Overall stream habitat score (using the EPA RBP method) and invertebrate diversity index (Shannon Diversity Index - a commonly employed index of population heterogeneity) at the nine sites were correlated (Figure 20). In addition, two distinct site groupings were recognized. Four sites assigned higher habitat scores (based on modified RBP) had a noticeably lower invertebrate diversity index than some sites with lower habitat scores. These observations may indicate the effects of non-habitat related influences on those invertebrate

Barbour, M.T., Gerritsen, J., Snyder, B.D., and Stribling, J.B. Revision to Rapid Bioassessment Protocols for Use in Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish. EPA 841-D-97-002. USEPA, Washington, D.C.

Etnier, D.A. and Starnes, W.C. 1993. The Fishes of Tennessee. The University of Tennessee Press. Knoxville, TN. 681 pp.

Ross, S.T. and Brenneman, W.M. 1991. Distribution of Freshwater Fishes in Mississippi. Freshwater Fisheries Report Number 108. D-J Project Completion Report. Mississippi Department of Wildlife, Fisheries and Parks. Bureau of Fisheries and Wildlife. Jackson, MS. 548 pp.

Simon, A.J. 1998. Processes and Forms of the Yalobusha River System: A Detailed Geomorphic Evaluation. Prepared for: Demonstration Erosion control Porject, U.S. Army Corps of Engineers, Vicksburg District, Vicksburg, Mississippi. USDA-Agricultural Research Service, Channel and Watershed Processes Research Unit, National Sedimentation Laboratory. Oxford, Mississippi.

ACKNOWLEDGEMENTS

Partial funding for this project was provided by the U.S. Army Corps of Engineers. A number of other people assisted with data and sample collection and processing, and with manuscript production. Mr. Terry Welch assisted with many aspects of the project, and we greatly appreciate his efforts. Sammie Smith, Jr. and Scott S. Knight provided important technical support. Rebecca Maul and Jonathan Maul, Robert Cullum, Matt Huddleston, Jacob Stanley, Sara Davis, Jill Balducci, Brian Dahl, Ken Overstreet, Karen Konzen and Betty Hall provided additional notable support, and for this we thank them.

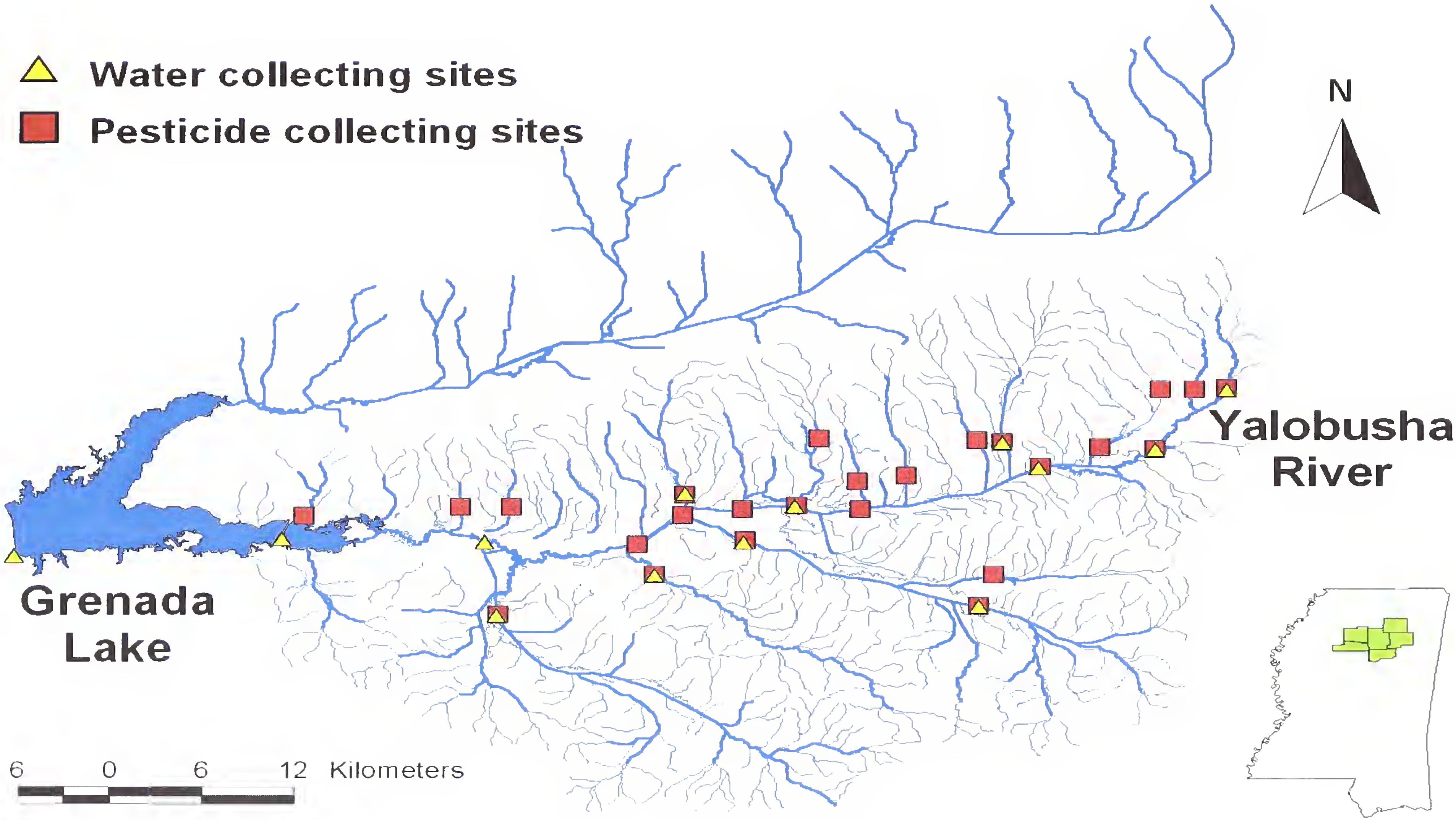


Figure 1. Sampling sites for collection of water samples for water quality analyses and sediment and water samples for contaminant analyses.

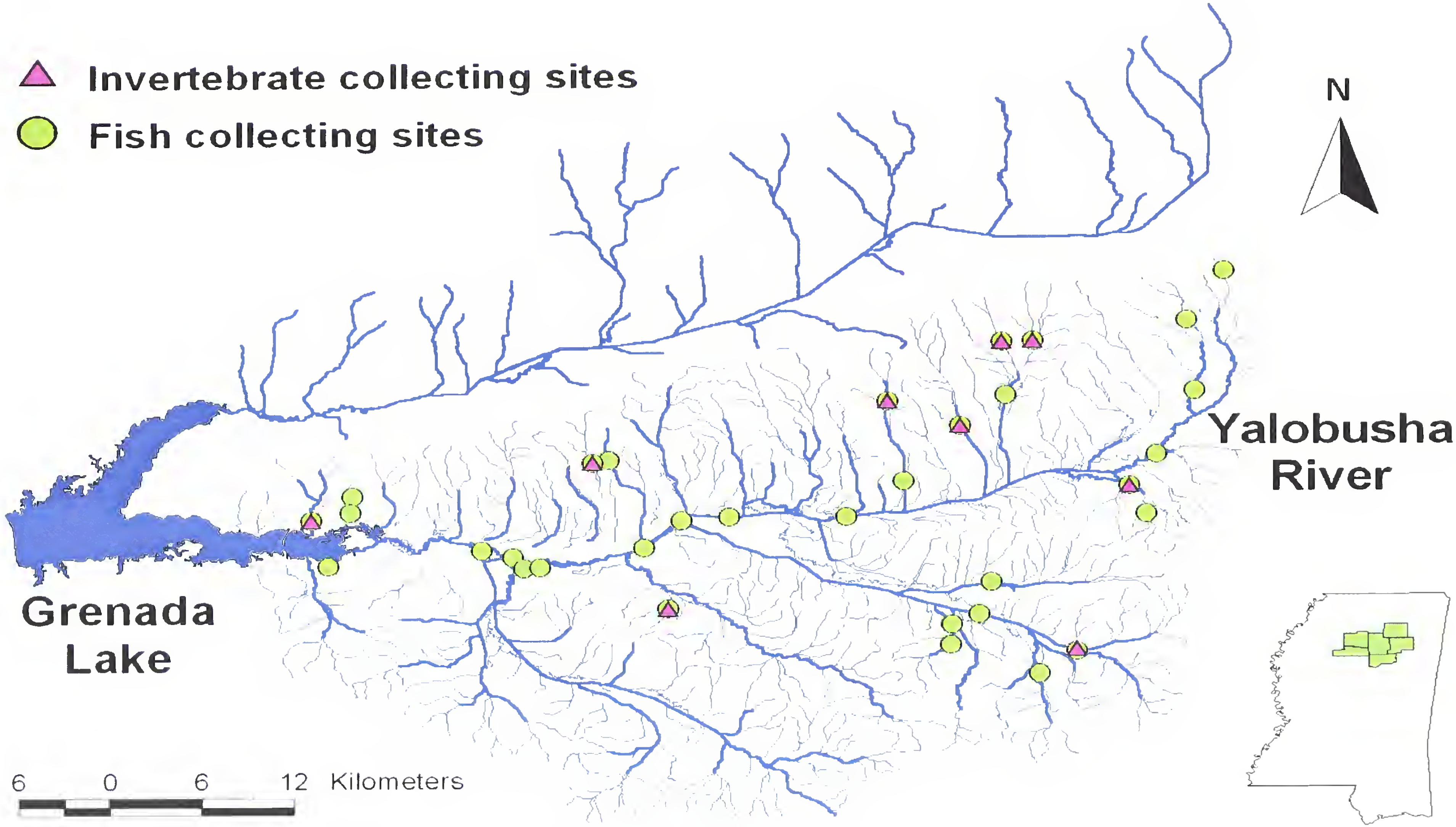


Figure 2. Sampling sites for collection of invertebrates and fish within the upper Yalobusha River Basin.

Figure 3. Water depth contour maps of reaches above (reaches 23-26, on right) and below (reaches 19-22, on left) the sediment and debris jam in the main channel of the Yalobusha River.

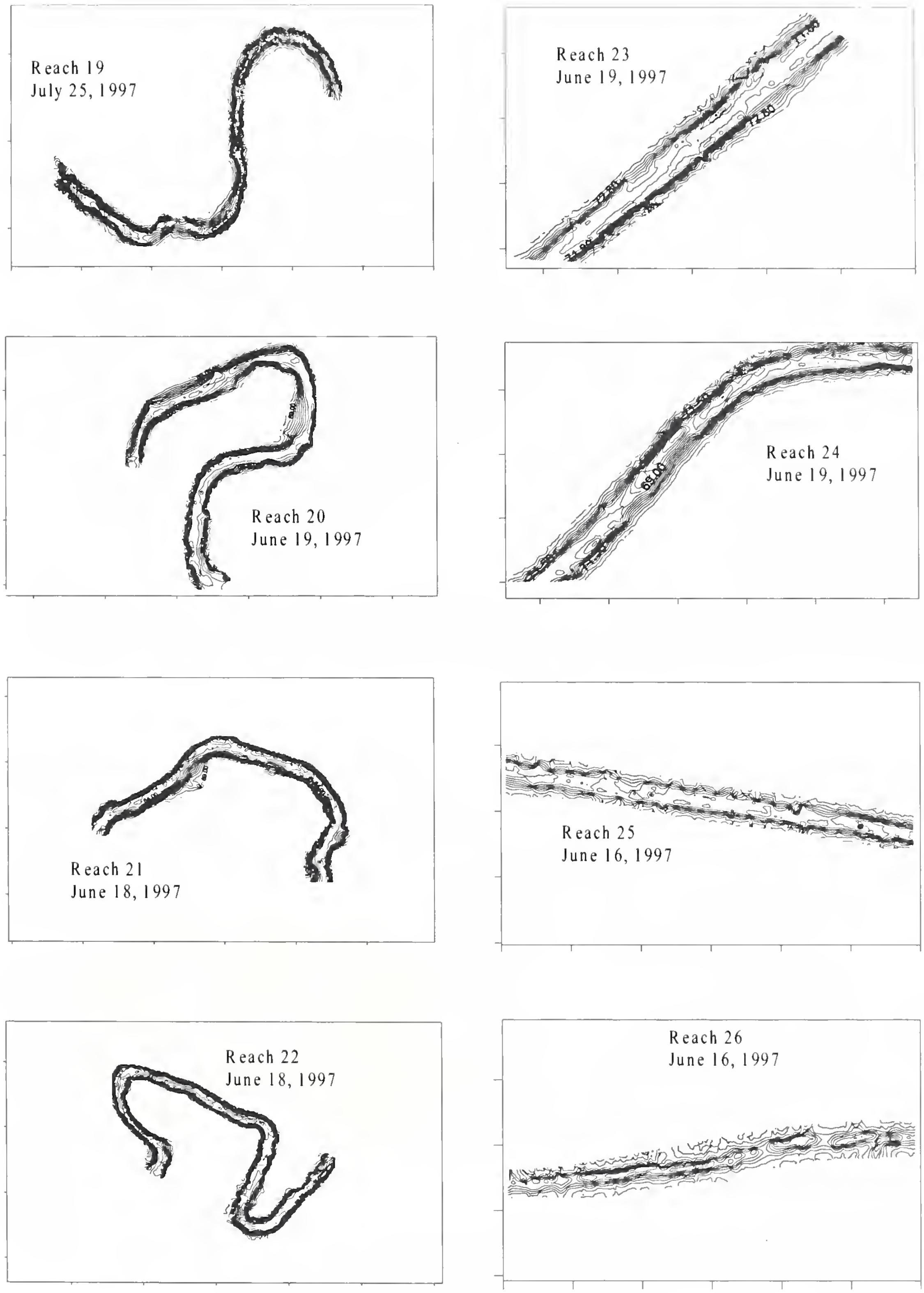
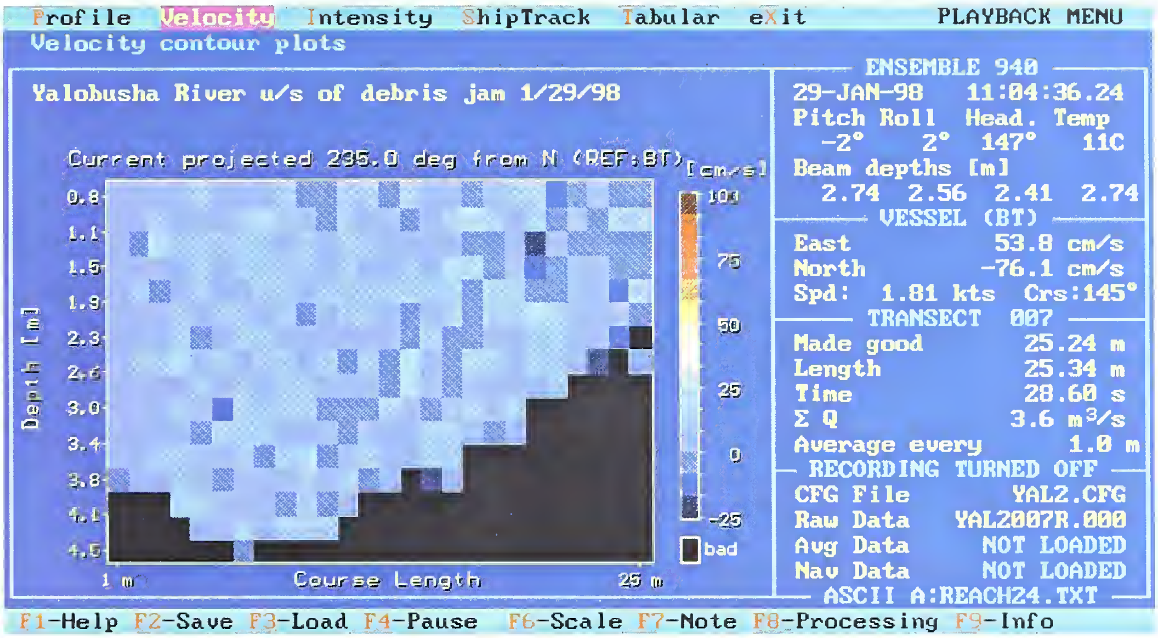


Figure 4. Velocity contour plots for cross sections above and below the sediment and debris jam in the main channel of the Yalobusha River. Velocity is projected in the direction of the channel centerline. Figures are screen dumps from TRANSECT program (RD Instruments, San Diego, CA).



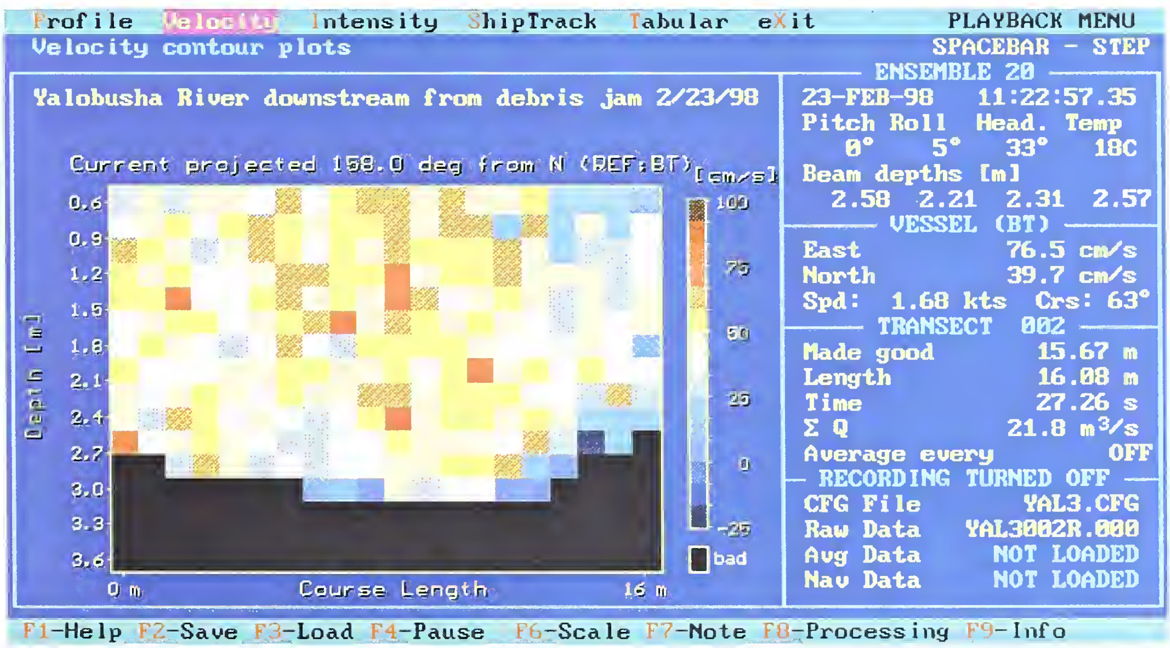
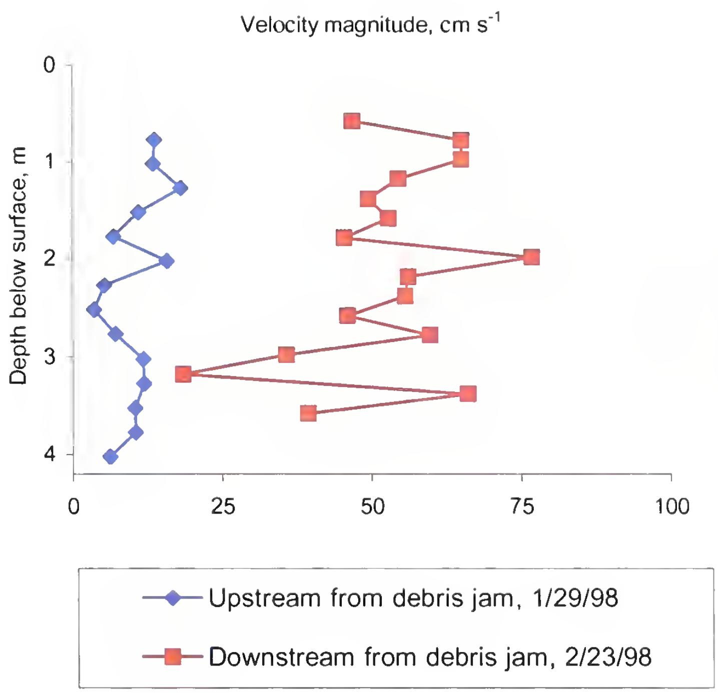
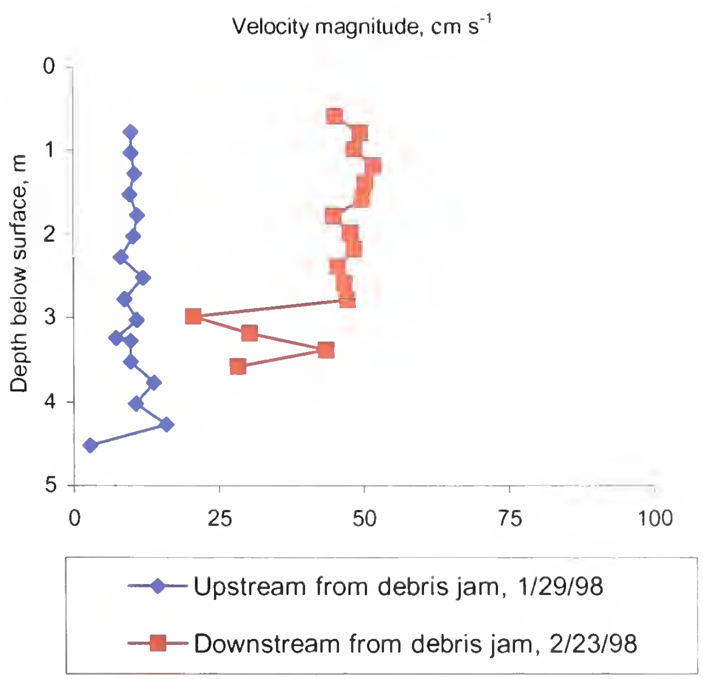


Figure 5. Typical vertical velocity profiles drawn from the data depicted in Figure 4. Upper plot shows profiles of the instantaneous magnitude of velocity (without regard to direction) located approximately in the center of each channel. Bottom plot shows profiles of the cross-sectional average instantaneous magnitude of velocity (without regard to direction).





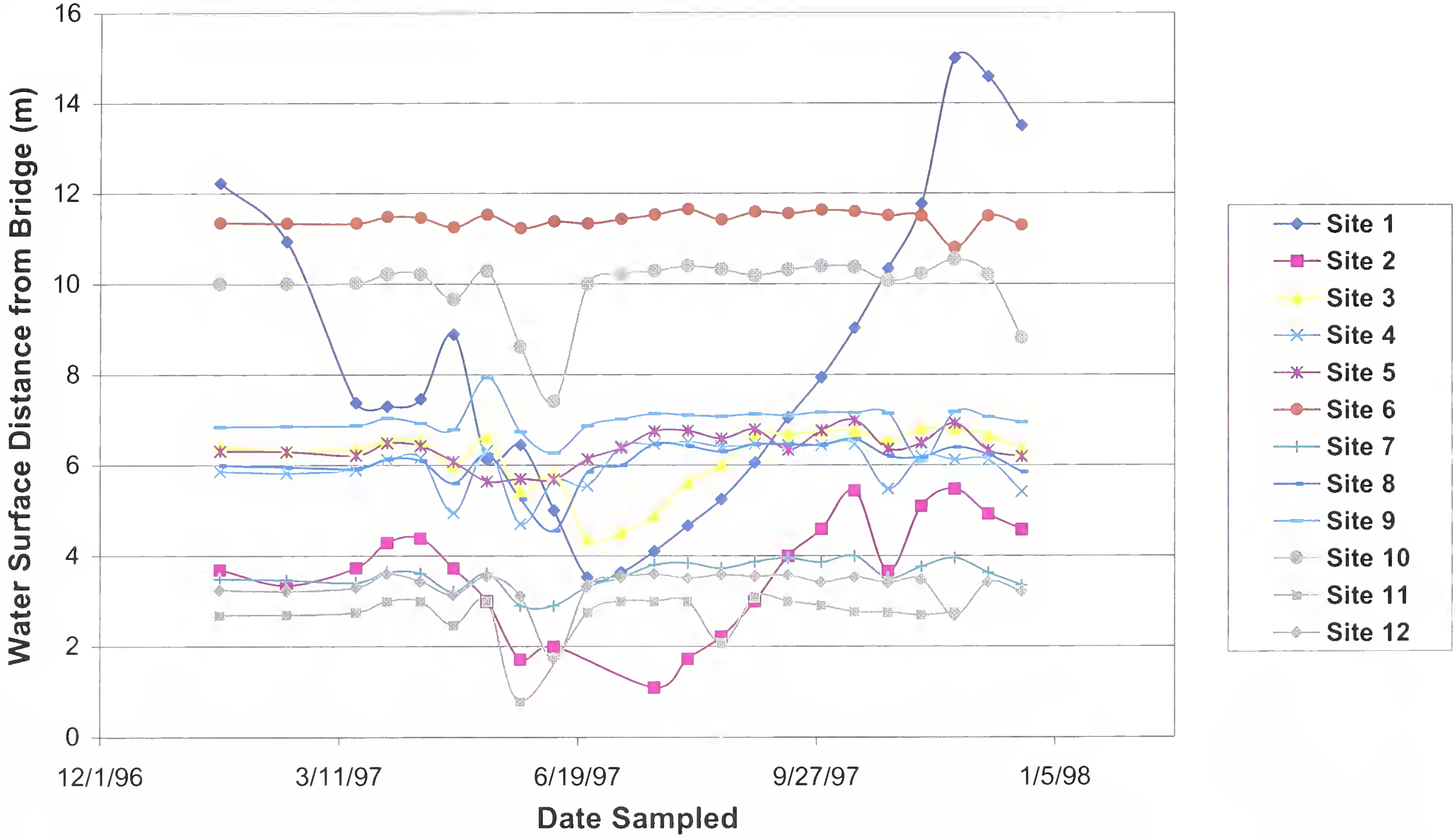


Figure 6. Water depth (meters) measured as the distance from the bridge to the water surface. (Increase in distance indicates less water in the river)

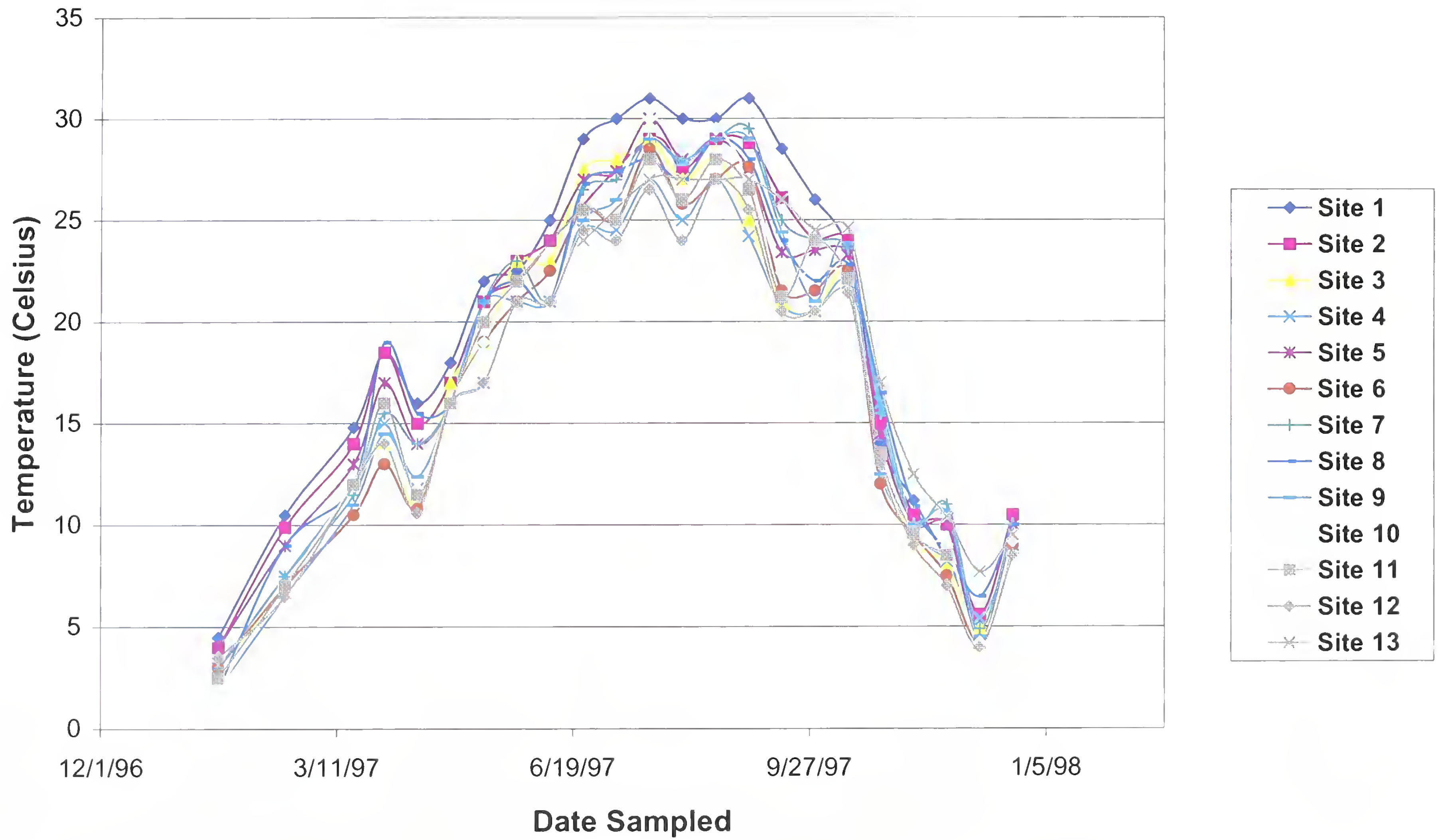


Figure 7. Water temperature (degrees Celsius) for individual sites located throughout the Yalobusha watershed.

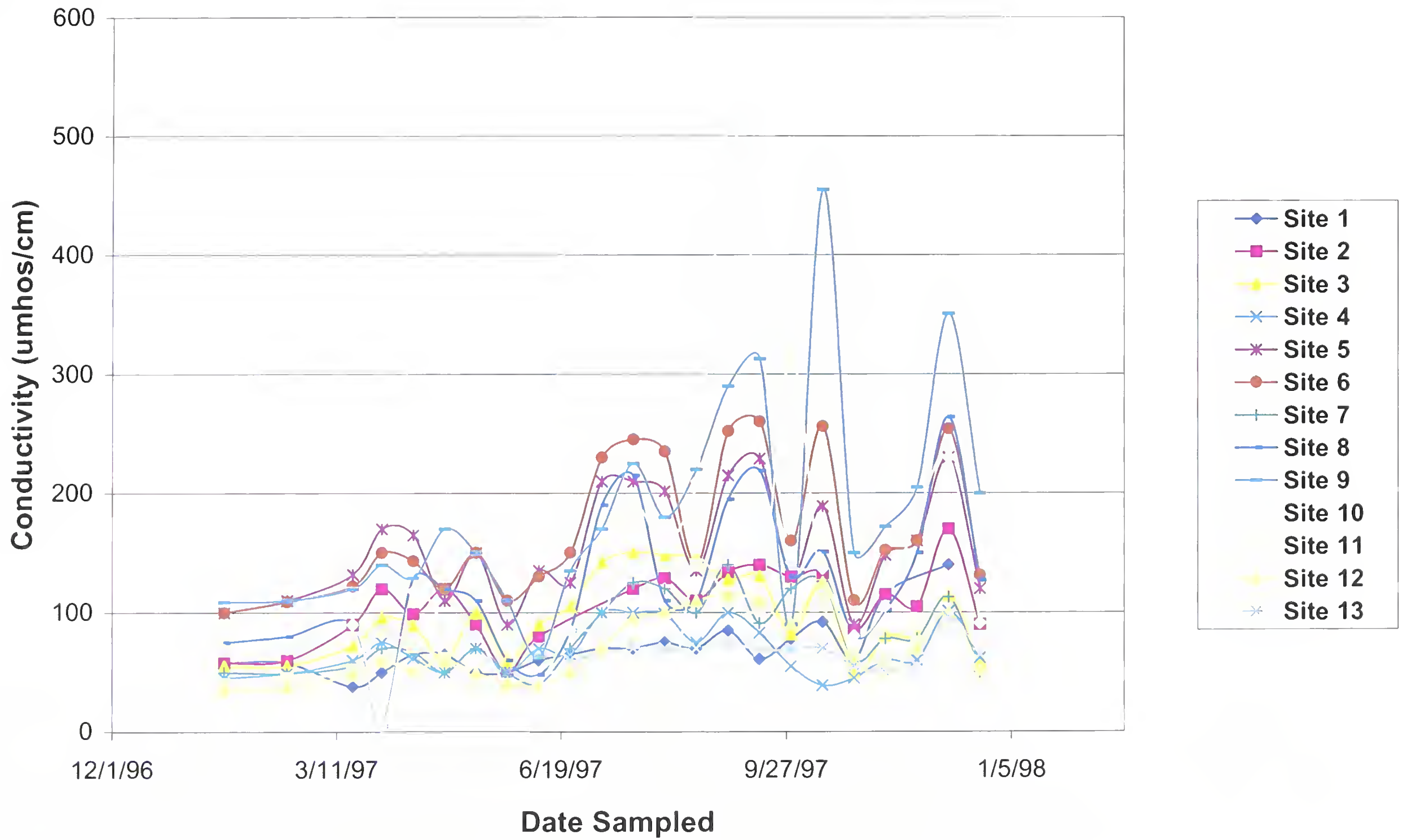


Figure 8. Conductivity (umhos/cm) for individual sites throughout the Yalobusha Watershed.

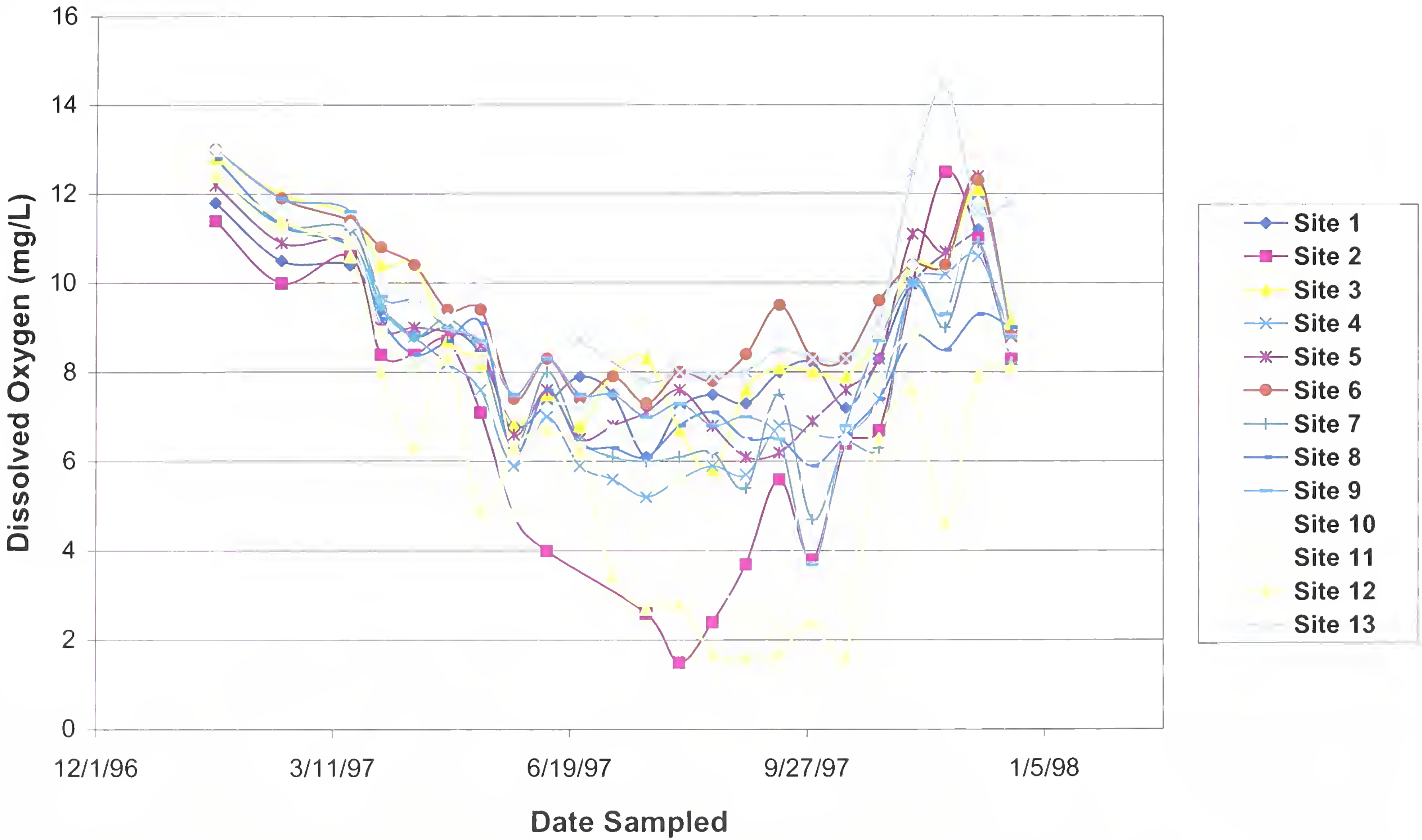


Figure 9. Dissolved oxygen (mg/L) for individual sites throughout the Yalobusha watershed.

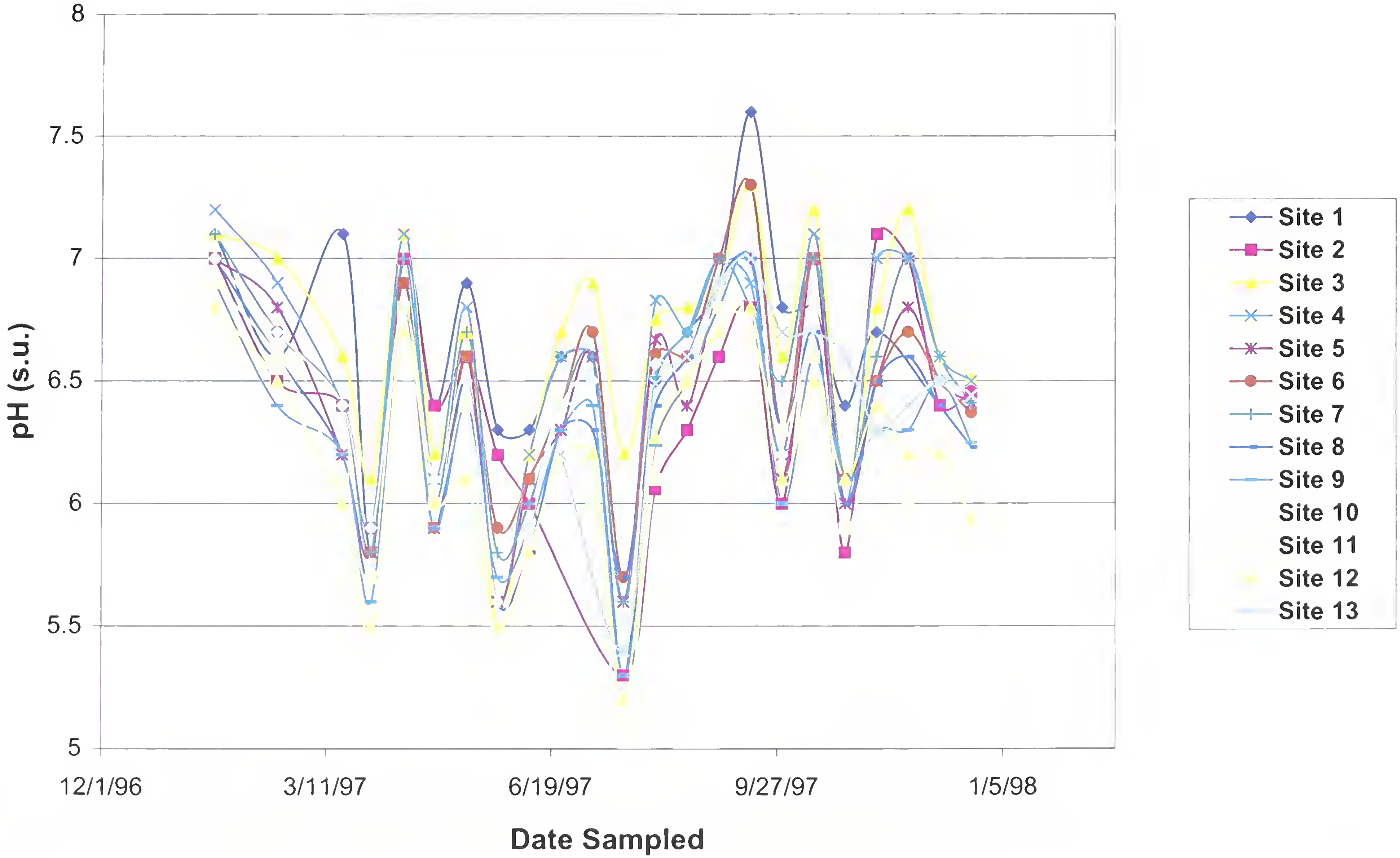


Figure 10. pH (s.u.) collected for individual sites within the Yalobusha watershed.

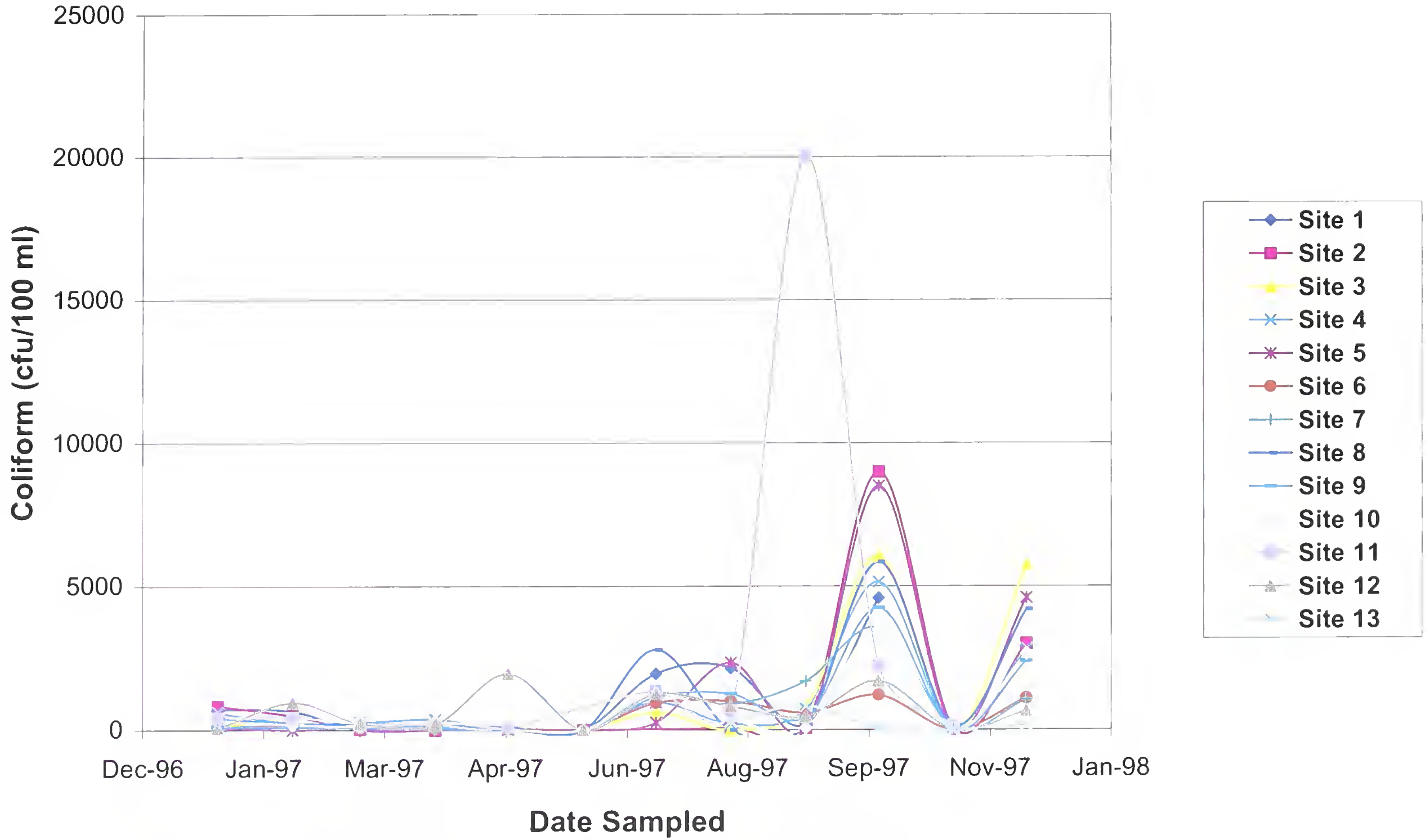


Figure 11. Coliform colonies (cfu/100ml) measured monthly in Yalobusha watershed samples.

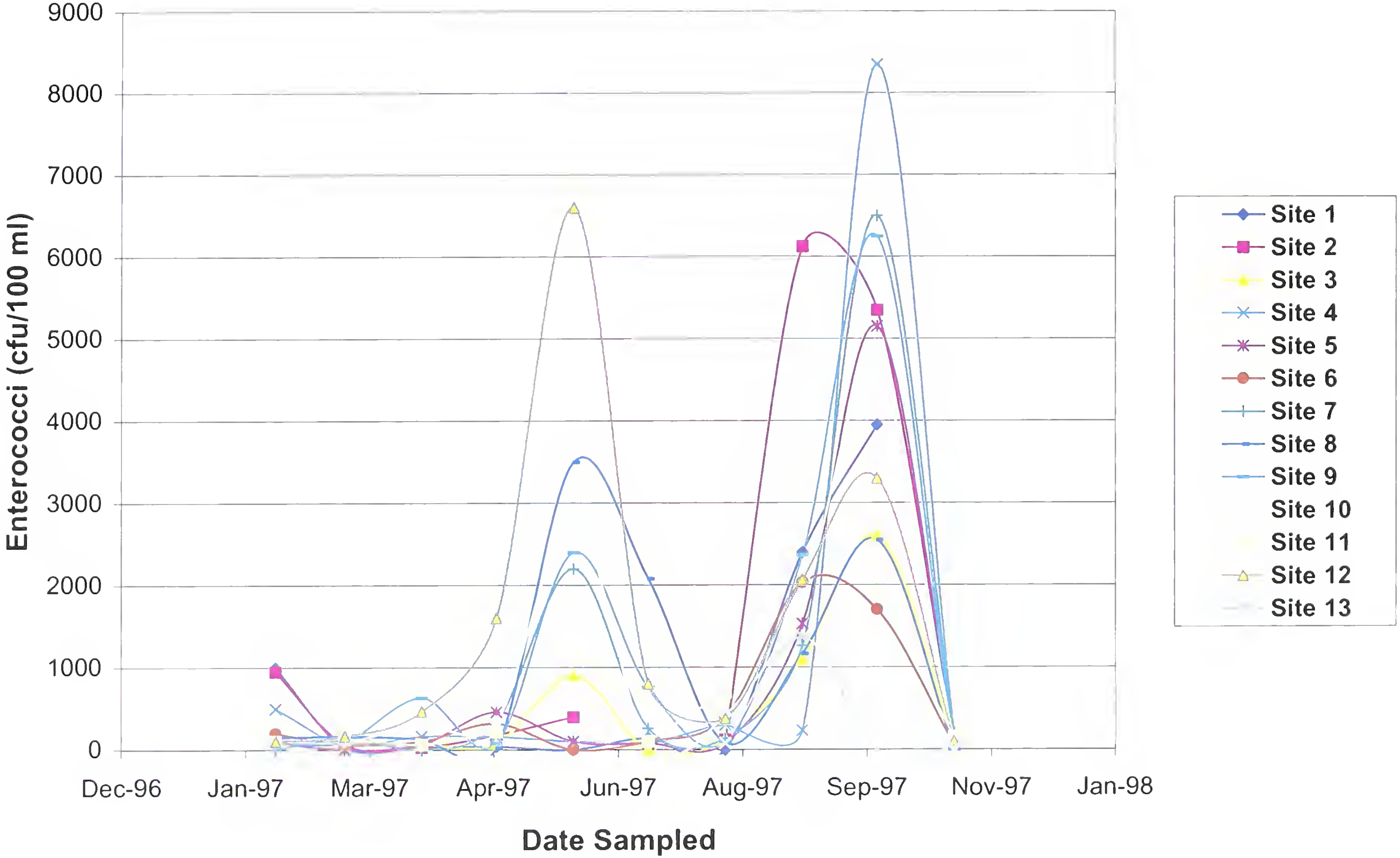


Figure 12. Enterococci colonies (cfu/100ml) measured monthly in Yalobusha watershed samples.

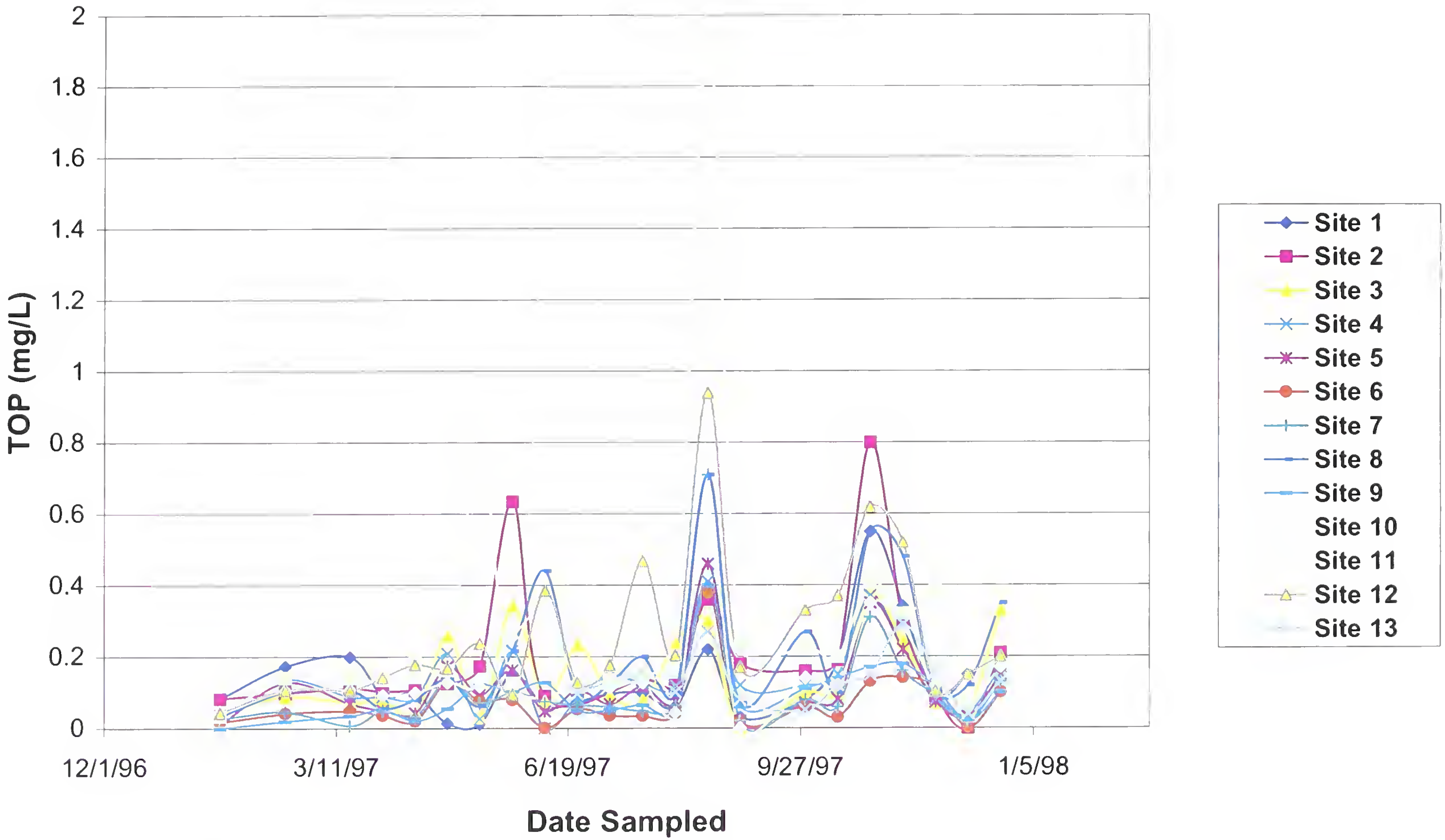


Figure 13. Total orthophosphorous (mg/L) measured in aqueous samples collected from throughout the Yalobusha watershed.

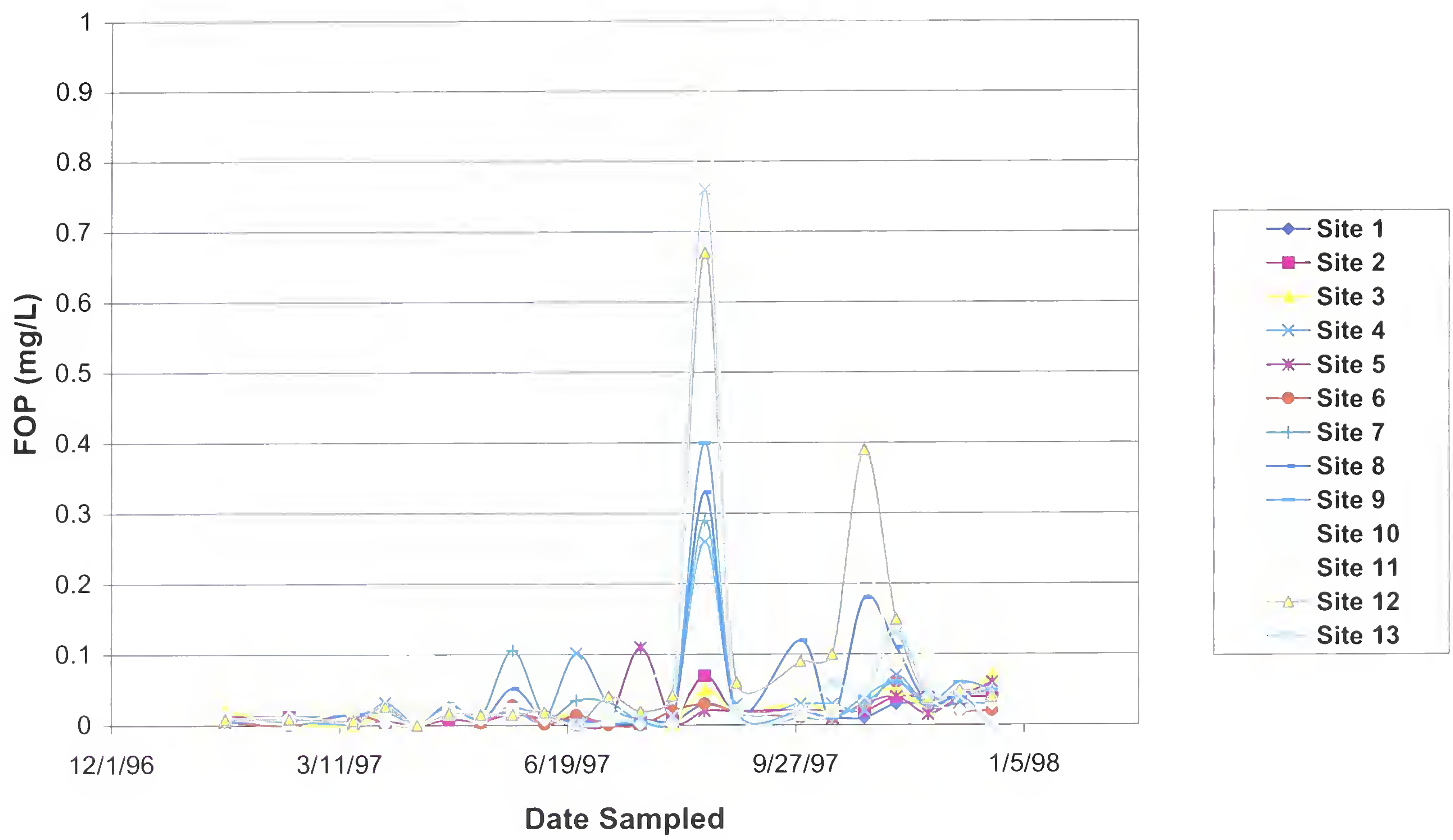


Figure 14. Filtered orthophosphorous (mg/L) measured in aqueous samples collected from throughout the Yalobusha watershed.

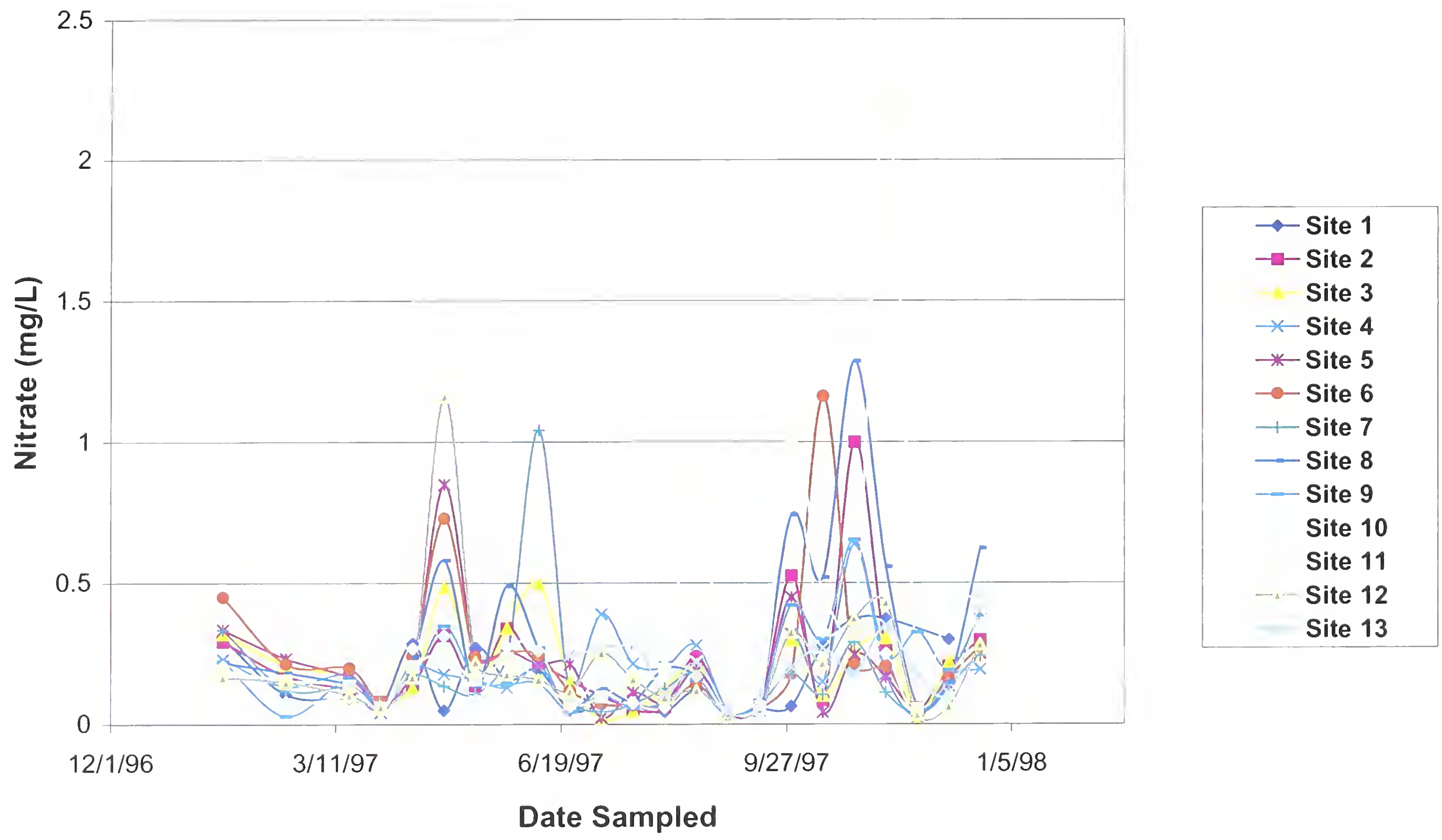


Figure 15. Nitrate (mg/L) measured in aqueous samples collected from throughout the Yalobusha watershed.

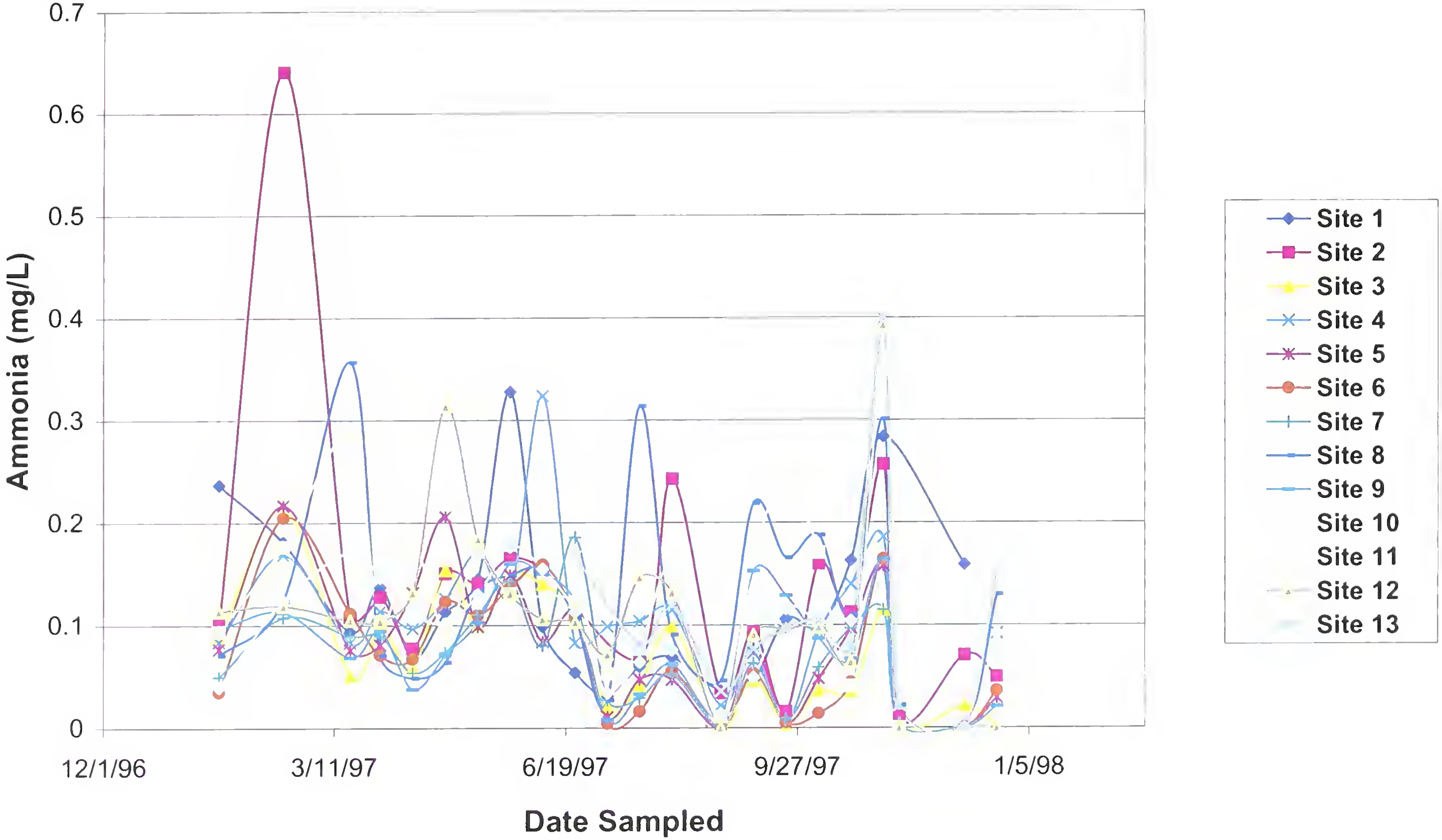


Figure 16. Ammonia (mg/L) measured in aqueous samples collected from throughout the Yalobusha watershed.

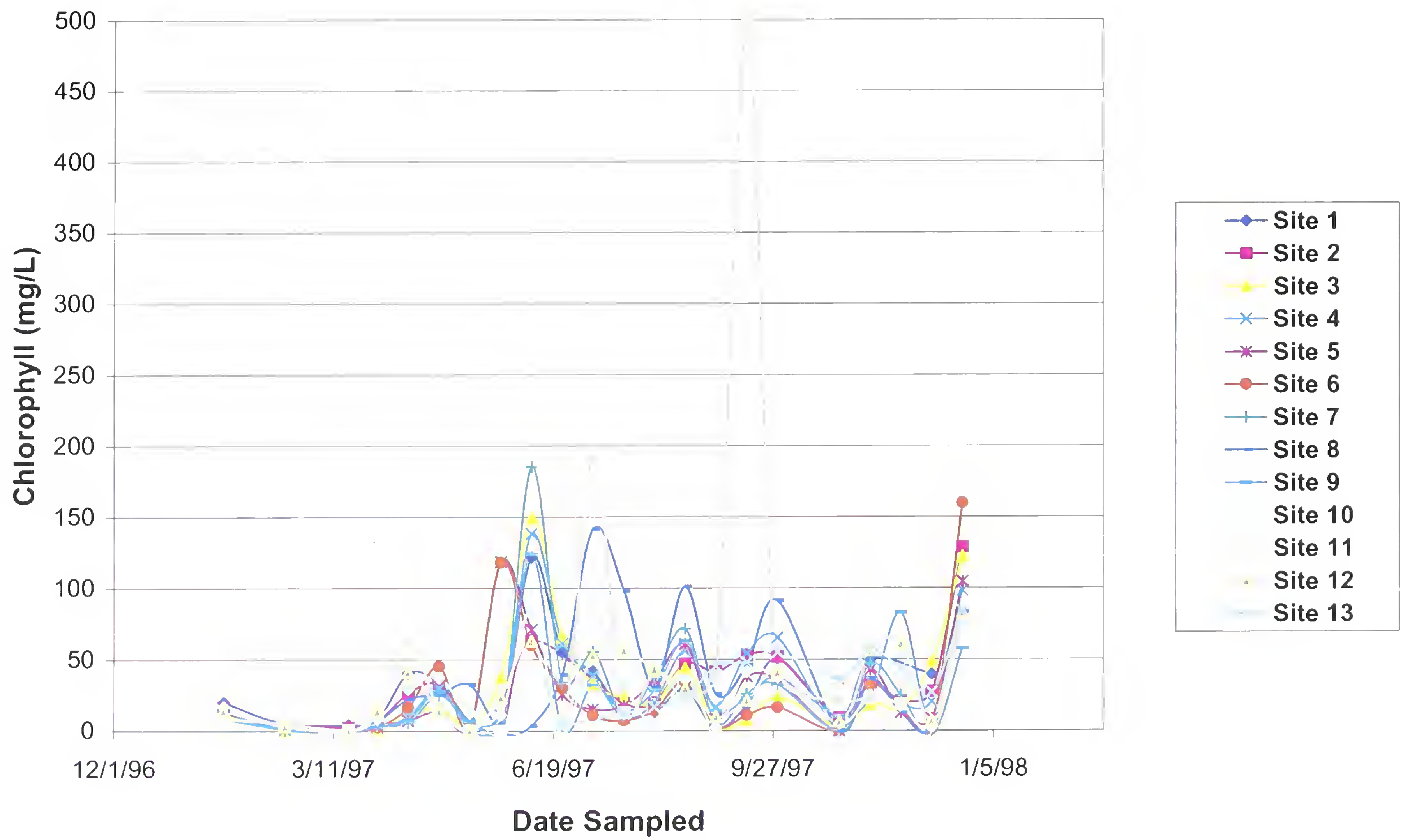


Figure 17. Chlorophyll concentrations (mg/L) measured in samples collected from throughout the Yalobusha watershed .

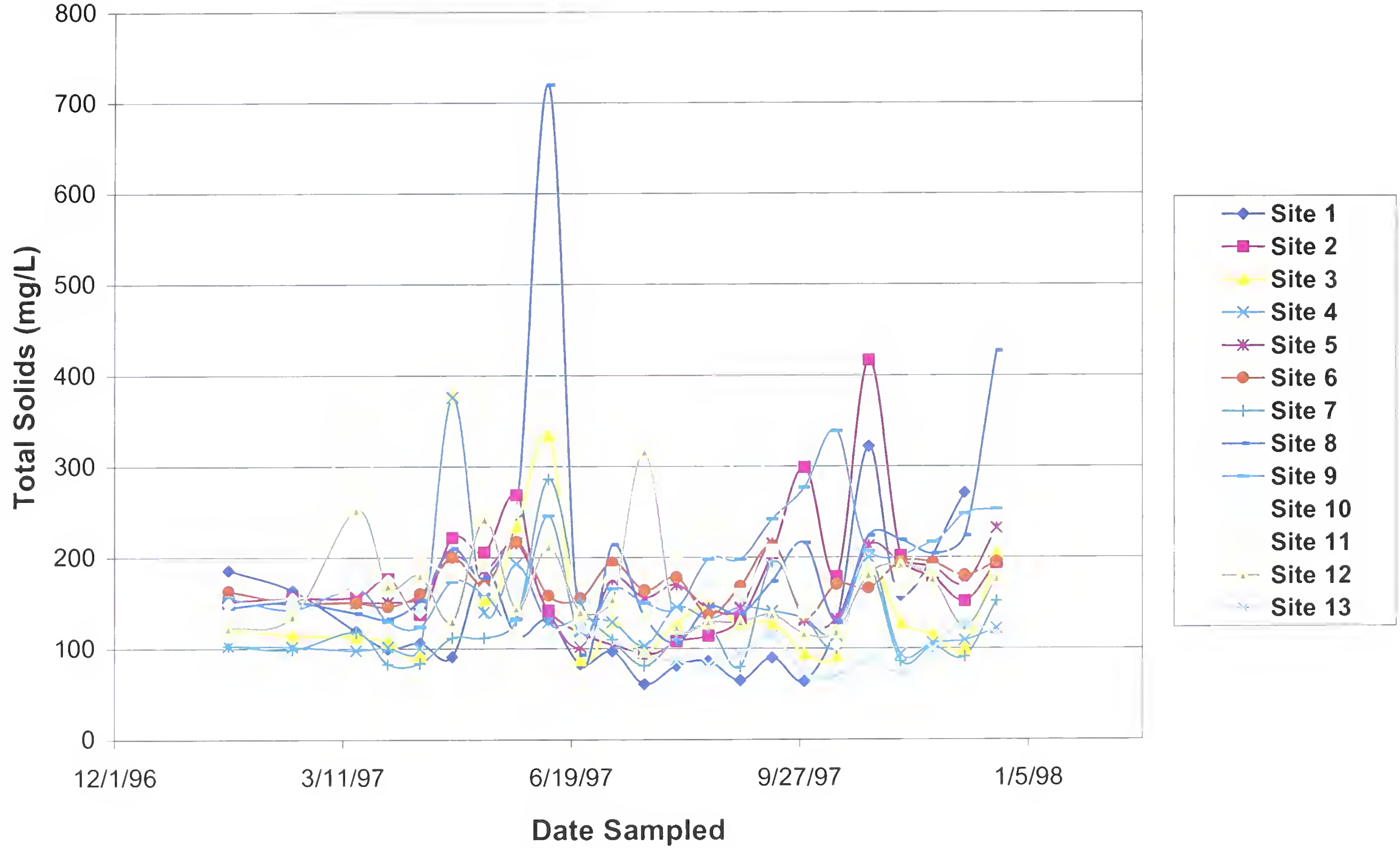


Figure 18. Total solid concentrations (mg/L) in water samples collected from throughout the Yalobusha watershed .

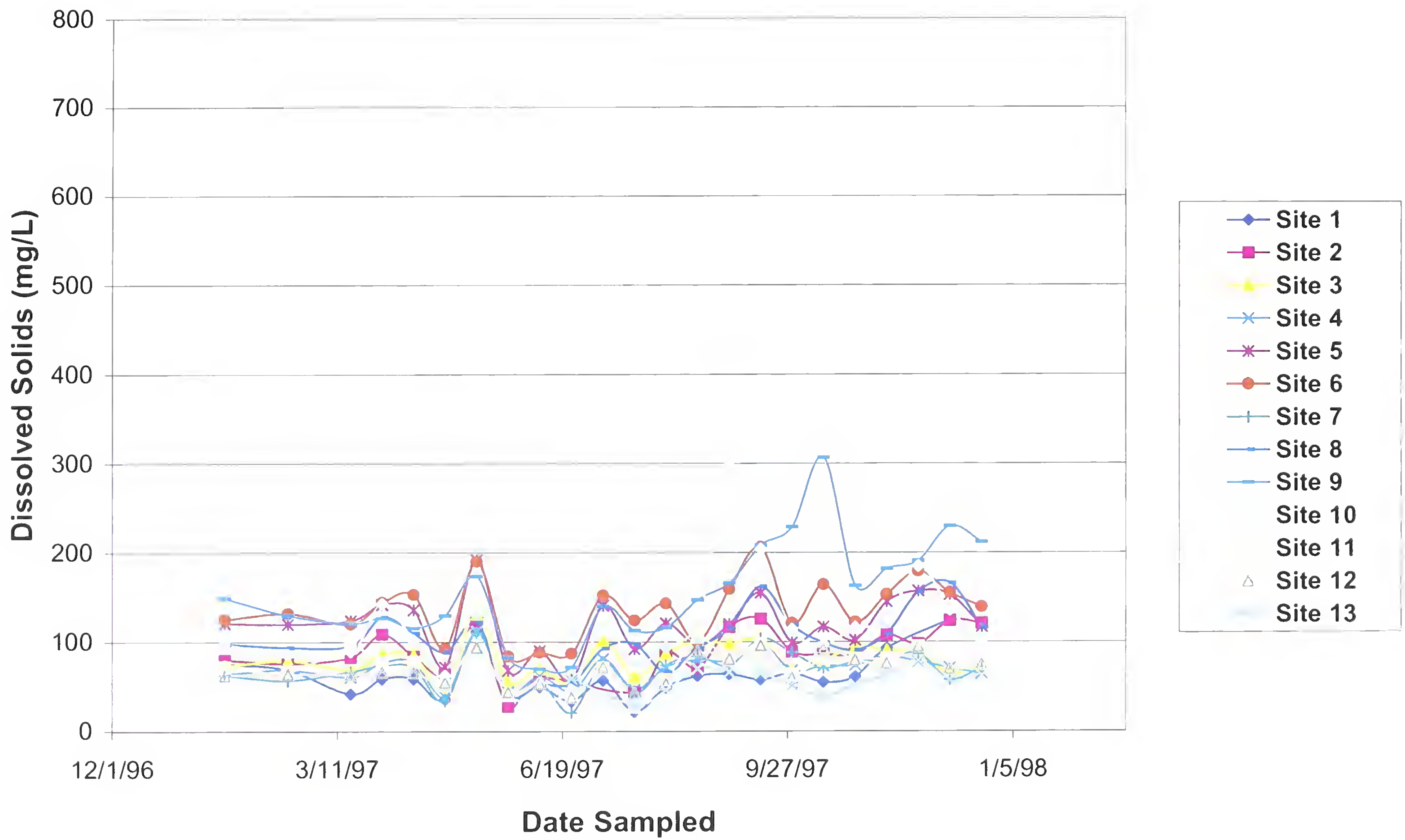


Figure 19. Dissolved solid concentrations (mg/L) in water samples collected from throughout the Yalobusha watershed .

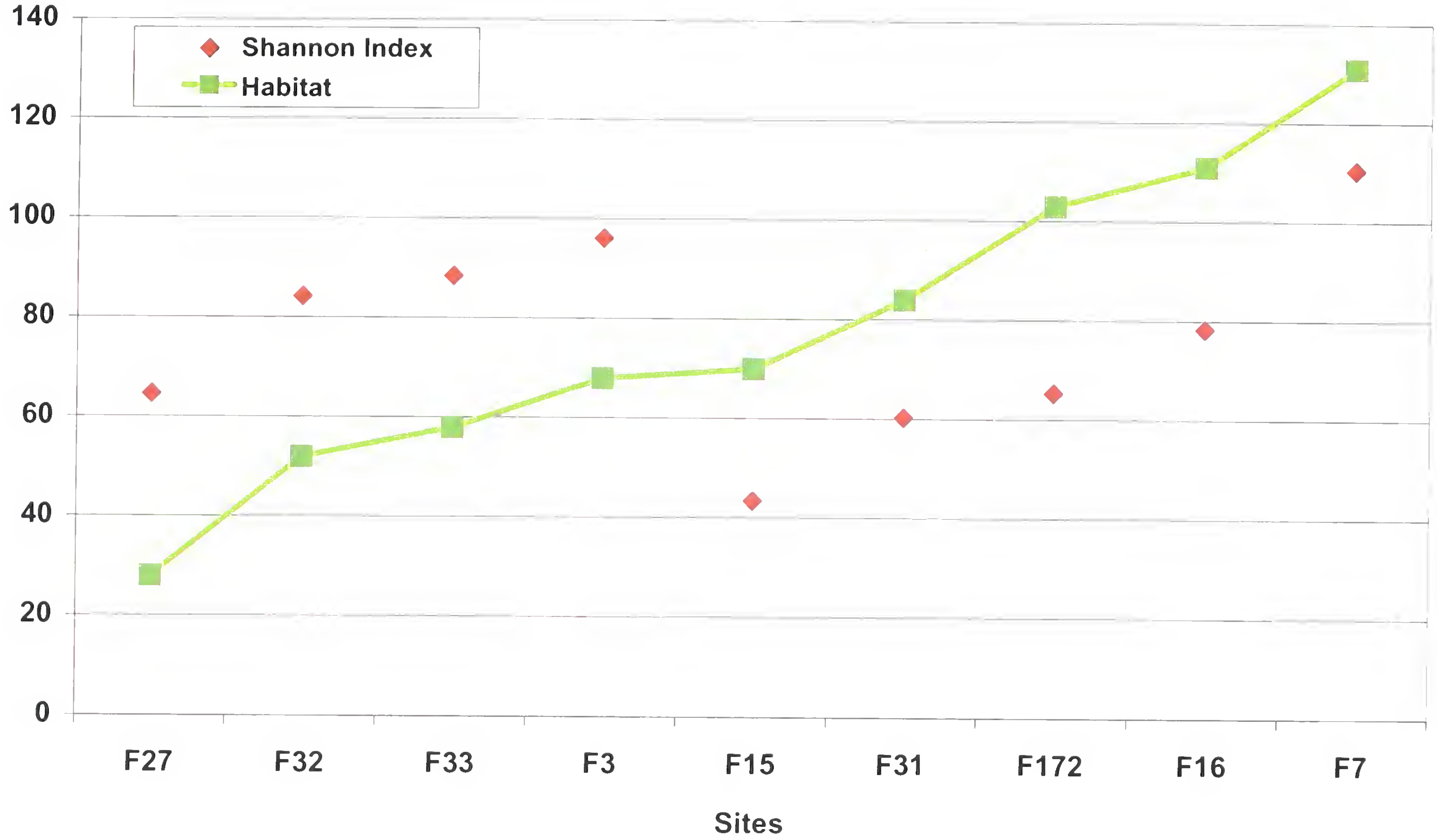


Figure 20. Stream habitat score versus invertebrate Shannon Heterogeneity Index. Index is multiplied by 100.

Table 1. Contaminants sought in sediment and water samples.

4,4'DDD	4,4'DDE	4,4'DDT
Aldicarb	Aldrin	Alpha BHC
Alpha Endosulfan	Arochlor 1016	Arochlor 1221
Arochlor 1232	Arochlor 1242	Arochlor 1248
Arochlor 1254	Arochlor 1260	Arsenic
Atrazine	Beta BHC	Beta Endosulfan
Chlordane	Copper	Cyfluthrin – A
Cyfluthrin – B	Cyfluthrin – C	Cyhalothrin
Delta BHC	Dieldrin	Endosulfan
Endrin	Endrin Sulfide	Fluometeron
Gamma BHC	Heptachlor	Heptachlor Epoxide
Lead	Mercury	Methoxychlor
Metolachlor	Norflurazon	Pendimethalin
Toxaphene	Tralomethrin	Trifluralin

Table 2. Contaminants sought in fish tissue.

4,4'DDD	4,4'DDE	4,4'DDT
Aldicarb	Aldrin	Alpha BHC
Arochlor 1016	Arochlor 1221	Arochlor 1232
Arochlor 1242	Arochlor 1248	Arochlor 1254
Arochlor 1260	Arsenic	Atrazine
Beta BHC	Chlordane	Copper
Cyfluthrin	Cyhalothrin	Delta BHC
Dieldrin	Endo Sulfate	Endosulfan I
Endosulfan II	Endrin	Endrin Sulfide
Fluometeron	Gamma BHC	Heptachlor
Heptachlor Epoxide	Lead	Methyl Parathion
Mercury	Methoxychlor	Metolachlor
Mirex	Norflurazon	Pendimethalin
Toxaphene	Trifluralin	

Table 3. Descriptive water quality statistics for Yalobusha watershed Site 1 (Demonstration Erosion Control).

Parameter	Mean	S.D.*	Min.	Max.	N
Depth (m)	7.72	3.10	3.53	14.59	22
Temperature ($^{\circ}$C)	20.40	8.82	4.5	31	22
Conductivity (μmhos/cm)	76.23	28.89	28	140	22
D.O. (mg/L)	8.46	1.46	6.1	11.8	22
pH (s.u.)	6.72	0.49	5.3	7.6	22
TS (mg/L)	138.35	76.50	61	322	20
DS (mg/L)	69.95	40.88	22	209	20
SS (mg/L)	68.40	57.16	1	261	20
FOP (mg/L)	0.017	0.018	ND**	0.086	23
TP (mg/L)	0.149	0.140	0.012	0.55	23
NH_4 (mg/L)	0.119	0.08	0.031	0.328	22
NO_3 (mg/L)	0.161	0.117	0.032	0.373	22
Chlorophyll (mg/L)	30.61	28.87	1.86	121.74	18
Coliform (cfu/100 ml)	15,007	45,328	ND	151,600	11
Enterococci (cfu/100 ml)	1,868	3,514	ND	11,120	10

*S.D. – Standard Deviation
** ND – None Detected

Table 4. Descriptive water quality statistics for Yalobusha watershed Site 2 (Demonstration Erosion Control).

Parameter	Mean	S.D.*	Min.	Max.	N
Depth (m)	3.78	1.62	1.10	7.14	22
Temperature (°C)	17.85	8.11	4	29	22
Conductivity (μmhos/cm)	114.45	49.04	48	260	22
D.O. (mg/L)	6.97	3.15	1.5	12.5	22
pH (s.u.)	6.55	0.52	5.3	7.26	22
TS (mg/L)	187.30	74.57	95	417	20
DS (mg/L)	92.30	32.93	28	173	20
SS (mg/L)	95.0	81.41	12	331	20
FOP (mg/L)	0.021	0.017	ND**	0.07	22
TP (mg/L)	0.199	0.189	ND	0.8	22
NH_4 (mg/L)	0.144	0.130	0.011	0.641	22
NO_3 (mg/L)	0.216	0.217	0.027	1.0	22
Chlorophyll (mg/L)	28.91	31.08	ND	128.83	17
Coliform (cfu/100 ml)	3,330	7,531	ND	25,800	12
Enterococci (cfu/100 ml)	1,352	2,335	20	6,127	10

*S.D. – Standard Deviation
** ND – None Detected

Table 5. Descriptive water quality statistics for Yalobusha watershed Site 3 (Demonstration Erosion Control).

Parameter	Mean	S.D.*	Min.	Max.	N
Depth (m)	6.39	1.32	4.37	10.19	24
Temperature ($^{\circ}C$)	17.26	8.31	3	29	24
Conductivity (μmhos/cm)	107.29	72.31	28	404	24
D.O. (mg/L)	8.77	1.84	5.8	12.8	24
pH (s.u.)	6.75	0.45	5.5	7.38	24
TS (mg/L)	162.86	90.74	88	383	22
DS (mg/L)	83.64	22.39	50	133	22
SS (mg/L)	79.23	91.85	8	328	22
FOP (mg/L)	0.025	0.022	ND**	0.087	24
TP (mg/L)	0.161	0.128	ND	0.385	24
NH_4 (mg/L)	0.08	0.06	ND	0.213	24
NO_3 (mg/L)	0.189	0.135	0.021	0.497	24
Chlorophyll (mg/L)	32.76	39.42	0.23	149.59	20
Coliform (cfu/100 ml)	13,900	45,449	ND	165,000	13
Enterococci (cfu/100 ml)	1,548	3,503	ND	11,840	11

*S.D. – Standard Deviation
** ND – None Detected

Table 6. Descriptive water quality statistics for Yalobusha watershed Site 4 (Demonstration Erosion Control).

Parameter	Mean	S.D.*	Min.	Max.	N
Depth (m)	5.88	0.76	3.36	6.52	22
Temperature (°C)	16.76	7.69	3	27	22
Conductivity (μmhos/cm)	66.73	22.10	28	101	22
D.O. (mg/L)	7.84	2.15	5.2	12.4	22
pH (s.u.)	6.63	0.49	5.6	7.27	22
TS (mg/L)	140.43	60.65	94	376	21
DS (mg/L)	70.57	17.51	39	112	21
SS (mg/L)	69.86	69.46	10	337	21
FOP (mg/L)	0.038	0.055	ND**	0.26	22
TP (mg/L)	0.149	0.106	ND	0.041	22
NH_4 (mg/L)	0.109	0.072	ND	0.324	22
NO_3 (mg/L)	0.195	0.130	0.023	0.637	22
Chlorophyll (mg/L)	34.88	35.54	ND	138.30	20
Coliform (cfu/100 ml)	1,009	1,588	ND	5,150	11
Enterococci (cfu/100 ml)	1,116	2,716	80	8,350	9

*S.D. – Standard Deviation
** ND – None Detected

Table 7. Descriptive water quality statistics for Yalobusha watershed Site 5 (Demonstration Erosion Control).

Parameter	Mean	S.D.*	Min.	Max.	N
Depth (m)	6.33	0.46	5.18	7.0	22
Temperature (°C)	18.44	8.63	4	30	22
Conductivity (μmhos/cm)	149.86	51.24	44	230	22
D.O. (mg/L)	8.50	1.97	6.1	12.4	22
pH (s.u.)	6.49	0.46	5.6	7.20	22
TS (mg/L)	170.05	33.94	102	232	21
DS (mg/L)	117.43	32.50	58	186	21
SS (mg/L)	52.62	39.95	ND**	148	21
FOP (mg/L)	0.022	0.025	ND	0.11	22
TP (mg/L)	0.126	0.110	ND	0.011	22
NH_4 (mg/L)	0.082	0.066	ND	0.217	22
NO_3 (mg/L)	0.204	0.180	0.024	0.849	22
Chlorophyll (mg/L)	31.86	33.47	ND	118.52	20
Coliform (cfu/100 ml)	1,458	2,750	ND	8,500	11
Enterococci (cfu/100 ml)	858	1,678	67	5,150	9

*S.D. – Standard Deviation
** ND – None Detected

Table 8. Descriptive water quality for Yalobusha watershed Site 6 (Demonstration Erosion Control).

Parameter	Mean	S.D.*	Min.	Max.	N
Depth (m)	11.4	0.20	10.8	11.65	22
Temperature (°C)	17.06	8.39	3	28.5	22
Conductivity (μmhos/cm)	166.32	61.13	62	260	22
D.O. (mg/L)	9.29	1.62	7.3	13.0	22
pH (s.u.)	6.54	0.42	5.7	7.30	22
TS (mg/L)	174.38	22.68	135	217	21
DS (mg/L)	135.67	32.96	84	206	21
SS (mg/L)	38.71	33.94	ND**	133	21
FOP (mg/L)	0.016	0.015	ND	0.06	22
TP (mg/L)	0.078	0.083	ND	0.38	22
NH_4 (mg/L)	0.07	0.062	ND	0.205	22
NO_3 (mg/L)	0.24	0.257	0.032	1.161	22
Chlorophyll (mg/L)	29.39	41.24	ND	159.73	20
Coliform (cfu/100 ml)	469	501	ND	1,200	11
Enterococci (cfu/100 ml)	545	764	ND	2,031	9

*S.D. – Standard Deviation
** ND – None Detected

Table 9. Descriptive water quality statistics for Yalobusha watershed Site 7 (Demonstration Erosion Control).

Parameter	Mean	S.D.*	Min.	Max.	N
Depth (m)	3.53	0.40	2.4	4.0	22
Temperature ($^{\circ}$C)	18.5	8.68	3	29.5	22
Conductivity (μmhos/cm)	80.77	32.64	30	140	22
D.O. (mg/L)	7.90	2.11	4.7	12.4	22
pH (s.u.)	6.57	0.45	5.6	7.4	22
TS (mg/L)	125.43	48.85	80	286	21
DS (mg/L)	68.76	22.01	21	110	21
SS (mg/L)	56.67	53.57	2	231	21
FOP (mg/L)	0.037	0.061	ND**	0.29	22
TP (mg/L)	0.116	0.148	0.02	0.71	22
NH_4 (mg/L)	0.06	0.048	ND	0.174	22
NO_3 (mg/L)	0.183	0.207	0.037	1.042	22
Chlorophyll (mg/L)	33.28	43.23	ND	185.43	20
Coliform (cfu/100 ml)	796	1,097	ND	3,550	11
Enterococci (cfu/100 ml)	1,212	2,113	ND	6,500	9

*S.D. – Standard Deviation
** ND – None Detected

Table 10. Descriptive water quality statistics for Yalobusha watershed Site 8 (Demonstration Erosion Control).

Parameter	Mean	S.D.*	Min.	Max.	N
Depth (m)	5.96	0.70	3.64	6.58	22
Temperature ($^{\circ}$C)	18.24	8.39	2	29	22
Conductivity (μmhos/cm)	126.55	59.56	34	264	22
D.O. (mg/L)	7.98	1.84	5.9	12.8	22
pH (s.u.)	6.43	0.44	5.6	7.26	22
TS (mg/L)	212.10	135.67	93	720	21
DS (mg/L)	102.05	33.28	41	166	21
SS (mg/L)	110.05	145.70	12	668	21
FOP (mg/L)	0.046	0.079	ND**	0.33	22
TP (mg/L)	0.210	0.184	0.034	0.71	22
NH_4 (mg/L)	0.126	0.082	ND	0.314	22
NO_3 (mg/L)	0.315	0.305	0.036	1.287	22
Chlorophyll (mg/L)	40.23	41.10	ND	141.83	20
Coliform (cfu/100 ml)	1,279	2,050	ND	5,850	11
Enterococci (cfu/100 ml)	1,075	1,326	ND	3,500	9

*S.D. – Standard Deviation
** ND – None Detected

Table 11. Descriptive water quality statistics for Yalobusha watershed Site 9 (Demonstration Erosion Control).

Parameter	Mean	S.D.*	Min.	Max.	N
Depth (m)	6.76	0.94	2.91	7.94	22
Temperature (°C)	17.74	8.73	2	29	22
Conductivity (μmhos/cm)	184.59	96.51	63	455	22
D.O. (mg/L)	8.49	2.09	3.7	13	22
pH (s.u.)	3.36	0.45	5.3	7.24	22
TS (mg/L)	194.5	58.82	115	339	20
DS (mg/L)	156.6	59.56	70	307	20
SS (mg/L)	37.9	35.81	ND**	176	20
FOP (mg/L)	0.036	0.083	ND	0.4	22
TP (mg/L)	0.097	0.084	ND	0.4	22
NH_4 (mg/L)	0.084	0.057	ND	0.166	22
NO_3 (mg/L)	0.198	0.155	0.029	0.653	22
Chlorophyll (mg/L)	28.06	32.11	ND	124.19	20
Coliform (cfu/100 ml)	893	1,349	ND	4,255	11
Enterococci (cfu/100 ml)	1,410	2,047	ND	6,250	9

*S.D. – Standard Deviation
** ND – None Detected

Table 12. Descriptive water quality statistics for Yalobusha watershed Site 10 (Demonstration Erosion Control).

Parameter	Mean	S.D.*	Min.	Max.	N
Depth (m)	9.75	1.12	5.98	10.54	22
Temperature (°C)	17.50	8.89	2	30	22
Conductivity (μmhos/cm)	139.73	109.77	30	510	22
D.O. (mg/L)	8.53	2.05	6.1	13	22
pH (s.u.)	6.45	0.46	5.5	7.27	22
TS (mg/L)	198.71	85.04	104	471	21
DS (mg/L)	114.48	57.74	45	297	21
SS (mg/L)	84.24	91.12	7	417	21
FOP (mg/L)	0.035	0.036	ND**	0.14	22
TP (mg/L)	0.0167	0.134	ND	0.61	22
NH_4 (mg/L)	0.098	0.076	ND	0.361	22
NO_3 (mg/L)	0.222	0.190	0.037	0.843	22
Chlorophyll (mg/L)	28.15	26.64	1.86	85.41	20
Coliform (cfu/100 ml)	794	1,198	ND	3,500	11
Enterococci (cfu/100 ml)	1,173	1,601	50	4,600	9

*S.D. – Standard Deviation
** ND – None Detected

Table 13. Descriptive water quality statistics for Yalobusha watershed Site 11 (Demonstration Erosion Control).

Parameter	Mean	S.D.*	Min.	Max.	N
Depth (m)	2.80	1.29	0.42	7.17	19
Temperature (°C)	18.15	8.21	2.5	28	19
Conductivity (μmhos/cm)	79.68	65.39	10	315	19
D.O. (mg/L)	6.64	2.92	2.2	12.4	19
pH (s.u.)	6.33	0.52	5.1	7.31	19
TS (mg/L)	166.28	35.94	114	239	18
DS (mg/L)	73.83	25.81	27	136	18
SS (mg/L)	92.44	29.89	38	143	18
FOP (mg/L)	0.100	0.210	ND**	0.093	19
TP (mg/L)	0.328	0.419	0.034	1.93	19
NH_4 (mg/L)	0.131	0.082	ND	0.35	19
NO_3 (mg/L)	0.356	0.518	0.041	2.209	19
Chlorophyll (mg/L)	59.50	121.66	ND	498.75	17
Coliform (cfu/100 ml)	2,846	6,487	100	20,045	9
Enterococci (cfu/100 ml)	462	671	67	1,900	7

*S.D. – Standard Deviation
** ND – None Detected

Table 14. Descriptive water quality statistics for Yalobusha watershed Site 12 (Demonstration Erosion Control).

Parameter	Mean	S.D.*	Min.	Max.	N
Depth (m)	3.21	0.59	1.33	3.6	22
Temperature (°C)	16.32	7.92	3.5	27	22
Conductivity (μmhos/cm)	69.73	30.40	24	125	22
D.O. (mg/L)	5.74	3.30	1.6	12.4	22
pH (s.u.)	6.28	0.47	5.2	7.42	22
TS (mg/L)	160.81	49.31	116	316	21
DS (mg/L)	69.57	17.95	38	96	21
SS (mg/L)	91.24	54.13	26	273	21
FOP (mg/L)	0.087	0.154	ND**	0.67	22
TP (mg/L)	0.273	0.210	0.044	0.94	22
NH_4 (mg/L)	0.114	0.093	ND	0.393	22
NO_3 (mg/L)	0.219	0.236	0.034	1.162	22
Chlorophyll (mg/L)	31.52	24.82	ND	83.09	20
Coliform (cfu/100 ml)	733	683	ND	1,960	11
Enterococci (cfu/100 ml)	1,712	2,119	100	6,600	9

*S.D. – Standard Deviation
** ND – None Detected

Table 15. Descriptive water quality statistics for Yalobusha watershed Site 13 (Demonstration Erosion Control).

Parameter	Mean	S.D.*	Min.	Max.	N
Depth (m)	-----	-----	-----	-----	-----
Temperature ($^{\circ}$C)	20.32	7.68	7.7	27	13
Conductivity (μmhos/cm)	67.15	11.46	50	96	13
D.O. (mg/L)	9.61	2.18	7.8	14.4	13
pH (s.u.)	6.48	0.39	5.4	7.0	13
TS (mg/L)	95.08	19.36	70	127	13
DS (mg/L)	56.85	13.22	30	79	13
SS (mg/L)	35.5	22.02	ND**	70	13
FOP (mg/L)	0.088	0.205	ND	0.76	13
TP (mg/L)	0.131	0.077	0.04	0.29	13
NH_4 (mg/L)	0.107	0.100	ND	0.399	13
NO_3 (mg/L)	0.202	0.107	0.044	0.401	13
Chlorophyll (mg/L)	37.53	22.55	3.2	83.96	12
Coliform (cfu/100 ml)	267	337	ND	833	5
Enterococci (cfu/100 ml)	361	670	ND	1,365	4

*S.D. – Standard Deviation
** ND – None Detected

Table 16 (year 1996). Concentrations of contaminants detected in waters collected from the Yalobusha watershed (x = not sampled, nd = not detected). Concentrations are in ppb.

Site No.	Date	As	Cu	Aldrin	Atrazine	Cyfluthrin-B	Cyhalothrin (Karate)	DDE	DDD	DDT	Dieldrin	Endosulfan	Heptachlor	Metolachlor	Norflurazon (Zorial)	Tralomethrin (Scout)
17P-1	10/29/96	0.83	nd	0.008	nd	nd	nd	0.011	nd	nd	0.001	nd	0.029	0.152	0.062	nd
17P-2	10/29/96	1.20	nd	nd	nd	nd	nd	0.010	nd	nd	nd	0.012	0.007	0.216	0.116	nd
17P-3	10/29/96	1.98	nd	nd	nd	nd	nd	0.005	nd	nd	nd	0.011	nd	1.024	0.067	nd
17P-4	10/29/96	1.18	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	1.416	0.030	nd
17P-5	10/29/96	1.00	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.002	0.132	nd	nd
17P-6	10/29/96	1.83	nd	nd	nd	nd	nd	0.003	nd	nd	nd	nd	0.005	0.186	nd	nd
17P-7	10/29/96	1.33	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.007	0.208	nd	nd
17P-8	10/29/96	1.58	nd	nd	9.863	nd	nd	0.004	nd	nd	nd	nd	0.010	0.127	0.015	nd
17P-9	10/29/96	1.73	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.703	nd	nd
17P-10	10/29/96	1.53	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.008	nd	0.090	nd	nd
17P-11	10/29/96	1.18	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.010	nd	0.204	nd	nd
17P-12	10/29/96	1.88	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.015	0.008	0.130	0.053	nd
17P-13	10/29/96	1.68	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.230	0.007	nd
17P-14	10/29/96	0.80	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.011	nd	0.162	nd	nd
17P-15	10/29/96	1.58	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.005	0.061	0.008	nd
17P-16	10/29/96	0.95	nd	nd	0.369	nd	nd	nd	nd	nd	nd	0.012	0.004	nd	0.036	nd
17P-17	10/29/96	1.20	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.005	0.343
17P-18	10/29/96	1.28	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
17P-19	10/29/96	1.10	nd	nd	15.043	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
17P-20	10/29/96	1.60	nd	nd	11.824	0.034	nd	nd	nd	nd	nd	nd	0.023	0.558	0.014	0.425
17P-21	10/29/96	1.95	10	nd	7.152	0.015	nd	0.005	nd	nd	nd	nd	nd	2.051	0.089	0.353
17P-22	10/29/96	1.23	10	nd	30.472	nd	nd	0.004	nd	nd	nd	nd	0.007	nd	0.058	nd
17P-23	10/29/96	1.28	10	nd	3.652	nd	0.097	nd	nd	nd	nd	nd	nd	0.059	0.078	0.410
17P-24	10/29/96	0.80	10	nd	56.644	nd	nd	nd	nd	nd	nd	nd	nd	0.109	0.122	nd
17P-25	10/29/96	0.60	10	nd	5.279	nd	nd	nd	nd	nd	nd	0.025	0.012	0.256	0.079	nd
17P-7	11/18/96	X	X	nd	5.037	nd	0.086	nd	nd	nd	nd	0.019	0.008	nd	0.063	0.381
17P-8	11/18/96	X	X	nd	54.181	nd	nd	0.012	nd	nd	nd	0.013	0.007	0.175	0.149	0.385
17P-16	11/18/96	X	X	nd	22.848	nd	nd	0.011	0.018	0.007	nd	nd	0.010	0.208	0.076	nd

Table 16 (continued : year 1997). Concentrations of contaminants detected in waters collected from the Yalobusha watershed (x = not sampled, nd = not detected). Concentrations are in ppb.

Site No.	Date	As	Cu	Pb	Hg	Atrazine	Cyfluthrin-A (Baythroid)	Cyfluthrin-B	Cyfluthrin-C	Cyhalothrin (Karate)	Norflurazon (Zorial)	Tralomethrin (Scout)
17P-1	7/7/97	1.68	nd	40	nd	nd	0.234	0.156	0.054	0.57	nd	0.192
17P-3	7/7/97	2.25	nd	70	nd	nd	nd	nd	nd	nd	nd	0.174
17P-4	7/7/97	4.13	nd	70	nd	nd	nd	nd	0.042	nd	nd	0.036
17P-5	7/7/97	3.23	nd	90	nd	nd	0.012	nd	0.066	nd	nd	0.114
17P-8	7/7/97	2.38	nd	90	nd	nd	0.468	0.156	0.456	nd	nd	0.222
17P-9	7/7/97	2.35	nd	70	nd	nd	0.012	0.012	nd	nd	nd	0.018
17P-10	7/7/97	1.4	nd	90	nd	nd	0.054	0.018	0.03	nd	nd	0.024
17P-1	11/10/97	0.22	10	30	0.03	nd	nd	nd	nd	nd	nd	nd
17P-2	11/10/97	0.98	nd	20	0.05	nd	nd	nd	nd	nd	nd	nd
17P-3	11/10/97	2.1	nd	30	0.01	nd	nd	nd	nd	nd	nd	nd
17P-4	11/10/97	0.98	10	30	0.06	nd	nd	nd	nd	0.0310	nd	nd
17P-5	11/10/97	nd	nd	40	0.03	nd	nd	nd	nd	0.0155	nd	nd
17P-6	11/10/97	1.63	10	30	0.03	nd	nd	nd	nd	0.0546	0.0054	nd
17P-7	11/10/97	nd	10	50	0.04	nd	nd	nd	nd	nd	0.0058	nd
17P-8	11/10/97	2.3	10	50	nd	nd	nd	nd	nd	0.0345	nd	nd
17P-9	11/10/97	1.23	10	50	0.07	nd	nd	nd	nd	0.0339	nd	nd
17P-10	11/10/97	0.9	10	80	nd	nd	nd	nd	nd	nd	nd	nd
17P-11	11/10/97	0.95	10	30	nd	nd	nd	nd	nd	nd	nd	nd
17P-12	11/10/97	1.25	10	70	0.17	nd	nd	nd	nd	nd	nd	nd
17P-13	11/10/97	2.6	nd	70	0.01	nd	nd	nd	nd	nd	nd	nd
17P-14	11/10/97	1.88	nd	80	0.01	nd	nd	nd	nd	nd	nd	nd
17P-15	11/10/97	0.4	nd	80	0.01	0.6085	nd	nd	nd	nd	0.0026	nd
17P-16	11/10/97	0.5	10	70	0.03	2.7877	nd	nd	nd	nd	0.0106	nd
17P-21	11/10/97	0.3	nd	30	nd	nd	nd	nd	nd	0.0427	nd	nd
17P-22	11/10/97	0.9	nd	40	0.01	nd	nd	nd	nd	nd	nd	nd
17P-23	11/10/97	0.45	nd	40	0.15	nd	nd	nd	nd	nd	nd	nd
17P-24	11/10/97	0.85	nd	100	0.05	nd	nd	nd	nd	nd	0.0066	nd
17P-25	11/10/97	0.85	nd	50	0.01	nd	nd	nd	nd	nd	nd	nd

Table 17. Concentrations of contaminants detected in sediments collected from the Yalobusha watershed (x = not sampled, ND = not detected). Concentrations are in ppb.

Site No.	Date	As	Cu	Pb	Hg	Aldrin	Atrazine	BHC (delta)	Cyfluthrin-A (Baythroid)	Cyfluthrin-B	Cyfluthrin-C	Cyhalothrin (Karate)	DDE	DDD	Endosulfan	beta-Endosulfan
17P-1	10/29/96	1506	5760	7590	7	nd	nd	X	0.004	nd	nd	nd	nd	0.001	nd	X
17P-2	10/29/96	2755	8480	14320	14	nd	nd	X	0.004	nd	nd	nd	nd	nd	nd	X
17P-3	10/29/96	3051	22250	34810	43	nd	nd	X	0.004	nd	nd	nd	0.001	nd	nd	X
17P-4	10/29/96	368	2800	3290	nd	nd	nd	X	nd	nd	nd	0.026	nd	nd	nd	X
17P-5	10/29/96	673	2830	4800	22	nd	nd	X	nd	nd	nd	nd	nd	nd	nd	X
17P-6	10/29/96	3228	17520	35570	55	nd	0.055	X	nd	nd	nd	nd	0.002	0.001	nd	X
17P-7	10/29/96	4415	22060	43520	59	nd	nd	X	nd	0.012	nd	0.028	0.008	0.010	0.003	X
17P-8	10/29/96	1040	9090	19180	36	nd	nd	X	nd	nd	0.013	nd	0.002	nd	nd	X
17P-10	10/29/96	1386	45200	69150	41	nd	nd	X	0.005	nd	nd	0.028	0.007	nd	nd	X
17P-11	10/29/96	6025	25870	156340	59	nd	nd	X	nd	nd	nd	nd	nd	nd	0.003	X
17P-12	10/29/96	4022	23770	113530	29	nd	nd	X	nd	nd	nd	nd	0.024	nd	0.009	X
17P-13	10/29/96	1153	13550	36330	33	nd	nd	X	0.016	nd	nd	0.026	nd	nd	0.003	X
17P-14	10/29/96	3747	40990	115590	33	nd	nd	X	nd	nd	nd	nd	nd	0.001	nd	X
17P-15	10/29/96	39	37320	68730	18	nd	nd	X	nd	nd	nd	nd	nd	nd	nd	X
17P-16	10/29/96	1057	34880	71630	102	nd	nd	X	nd	nd	nd	nd	nd	nd	nd	X
17P-17	10/29/96	X	X	X	X	nd	nd	X	nd	nd	nd	nd	0.002	0.002	nd	X
17P-17	10/29/96	5093	25600	50370	34	231.56	3.47	nd	nd	X	X	nd	nd	nd	nd	nd
17P-18	10/29/96	X	X	X	X	0.069	nd	X	nd	nd	nd	nd	0.004	0.007	0.007	X
17P-18	10/29/96	6487	20800	45320	47	826.97	18.93	42.32	nd	X	X	nd	nd	nd	nd	45.53
17P-19	10/29/96	X	X	X	X	nd	nd	X	nd	nd	nd	nd	nd	nd	nd	X
17P-19	10/29/96	5497	14890	26470	20	30.43	0.26	30.43	nd	X	X	nd	nd	nd	nd	8.76
17P-20	10/29/96	X	X	X	X	nd	nd	X	nd	nd	nd	nd	nd	nd	nd	X
17P-20	10/29/96	6324	5170	47490	29	nd	1.16	nd	nd	X	X	nd	nd	nd	nd	nd
17P-21	10/29/96	3728	17550	22910	19	nd	nd	X	nd	nd	nd	nd	nd	nd	nd	X
17P-22	10/29/96	370	1860	3630	nd	nd	nd	X	nd	nd	nd	0.023	nd	nd	0.007	X
17P-23	10/29/96	707	14640	25140	5	nd	nd	X	nd	nd	nd	nd	nd	nd	nd	X
17P-24	10/29/96	3656	18320	32380	20	nd	nd	X	nd	nd	nd	nd	nd	nd	nd	X
17P-25	10/29/96	428	2250	4340	10	nd	nd	X	nd	nd	nd	nd	nd	nd	0.001	X

Table 17 (continued). Concentrations of contaminants detected sediments collected from the Yalobusha watershed (x = not sampled, ND = not detected). Concentrations are in ppb.

Site No.	Date	Endrin	Fluometuron	Heptachlor	Methoxychlor	Metolachlor	Norflurazon (Zorial)
17P-1	10/29/96	nd	X	0.002	nd	0.023	nd
17P-2	10/29/96	nd	X	0.001	nd	nd	nd
17P-3	10/29/96	nd	X	0.001	nd	nd	nd
17P-4	10/29/96	nd	X	0.001	nd	nd	nd
17P-5	10/29/96	nd	X	0.015	nd	nd	0.490
17P-6	10/29/96	nd	X	0.006	0.033	0.022	3.026
17P-7	10/29/96	0.003	X	0.007	0.344	0.292	5.565
17P-8	10/29/96	nd	X	0.013	nd	nd	0.738
17P-10	10/29/96	nd	X	0.013	nd	nd	0.004
17P-11	10/29/96	nd	X	0.001	nd	nd	0.008
17P-12	10/29/96	0.011	X	0.016	0.352	nd	0.090
17P-13	10/29/96	0.001	X	0.015	nd	nd	0.036
17P-14	10/29/96	nd	X	0.009	nd	nd	1.036
17P-15	10/29/96	nd	X	0.007	nd	nd	4.742
17P-16	10/29/96	nd	X	0.009	nd	nd	0.007
17P-17	10/29/96	nd	X	0.055	0.670	nd	2.676
17P-17	10/29/96	nd	nd	0.28	X	nd	nd
17P-18	10/29/96	0.014	X	0.161	0.566	nd	2.390
17P-18	10/29/96	nd	34.48	nd	X	nd	nd
17P-19	10/29/96	nd	X	0.009	nd	nd	0.008
17P-19	10/29/96	nd	nd	nd	X	nd	nd
17P-20	10/29/96	nd	X	0.008	nd	0.009	0.008
17P-20	10/29/96	nd	nd	nd	X	nd	nd
17P-21	10/29/96	nd	X	0.002	nd	0.010	0.010
17P-22	10/29/96	nd	X	0.001	nd	0.007	0.012
17P-23	10/29/96	nd	X	nd	nd	0.004	0.012
17P-24	10/29/96	nd	X	nd	nd	nd	0.003
17P-25	10/29/96	nd	X	nd	nd	nd	0.004

Site No.	Date	As	Cu	Pb	Hg	BHC (beta)	BHC (delta)	BHC (gamma)
17P-1	11/10/97	1082	7520	11860	26.2	nd	nd	nd
17P-2	11/10/97	933	3450	6090	22.6	nd	nd	nd
17P-3	11/10/97	1238	9150	13780	28.7	nd	nd	nd
17P-4	11/10/97	360	1550	2840	8	nd	nd	nd
17P-5	11/10/97	453	1640	4030	8.9	nd	nd	nd
17P-6	11/10/97	2354	15410	23790	49.6	nd	nd	nd
17P-7	11/10/97	1737	8310	14890	15.6	nd	nd	nd
17P-8	11/10/97	nd	9010	25780	20.3	nd	nd	nd
17P-9	11/10/97	1101	5250	9690	13.1	nd	nd	nd
17P-10	11/10/97	1575	52300	87530	49.1	nd	nd	nd
17P-11	11/10/97	1596	9980	27490	39.2	nd	0.77	nd
17P-12	11/10/97	416	5670	17200	26.1	nd	nd	nd
17P-13	11/10/97	574	16830	25240	25	0.56	X	0.8
17P-14	11/10/97	191	22170	82280	33.9	nd	2.25	0.91
17P-15	11/10/97	347	22070	64111	29.1	nd	nd	nd
17P-16	11/10/97	420	18430	30430	26.1	nd	nd	1.83
17P-21	11/10/97	639	7730	11410	14.5	nd	nd	nd
17P-22	11/10/97	462	2590	6010	5.6	0.59	nd	nd
17P-23	11/10/97	429	5700	10020	5.8	nd	nd	nd
17P-24	11/10/97	254	12320	18980	19.6	3.51	nd	nd
17P-25	11/10/97	214	4920	7470	8.1	nd	nd	nd

Table 18. Concentrations of contaminants detected in different fish tissues collected from the Yalobusha watershed
(x = not sampled, nd = not detected). Concentrations are in ppb.

	FLESH	FLESH	FLESH	FLESH	FLESH	FLESH	WHOLE	WHOLE	WHOLE	WHOLE	WHOLE	WHOLE	WHOLE	WHOLE	VISCERA	VISCERA	VISCERA	VISCERA
Pb	x	x	x	nd	nd	nd	x	x	x	x	x	x	x	x	x	400	nd	3730
As	2960	3250	2600	32.1	14.1	15.5	3110	3770	3730	4020	3070	3120	2640	2480	950	15.3	7.1	67.5
Hg	nd	nd	311	69.6	54.4	51.2	572	217	439	564	nd	nd	nd	nd	nd	38.4	99.3	64.8
Cu	550	320	430	800	1070	110	1150	1270	770	1120	920	1250	460	610	1210	4200	90	4910
Atrazine	nd	0.03	nd	nd	1	nd	nd	nd	nd	nd	nd	0.26	0.6	0.28	0.24	nd	nd	nd
Fluometuron	nd	nd	nd	1.2	1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Metolachlor	nd	nd	22.58	x	x	x	nd	nd	nd	nd	19.32	8.92	nd	nd	35.26	x	x	x
Heptachlor	nd	nd	0.07	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Aldrin	0.53	nd	0.3	nd	nd	nd	1.74	0.74	nd	0.21	1.12	0.65	nd	nd	1.86	nd	nd	nd
Endosulfan I	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	1.05	nd	nd	nd	15.6
Endrin	nd	nd	nd	nd	0.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	200.1	nd
End. Aldehyde	nd	nd	nd	nd	nd	nd	5.08	2.55	nd	nd	0.95	nd	nd	nd	nd	nd	nd	nd
Methoxychlor	nd	0.09	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.53	nd	nd	nd	nd	nd
Endosulfan II	0.13	nd	1.14	nd	nd	nd	1.67	0.54	nd	nd	nd	0.58	nd	0.32	1.61	nd	nd	nd
Alpha BHC	0.16	nd	nd	4.2	0.4	0.1	10.79	0.03	0.09	0.15	0.16	0.25	0.31	0.58	0.64	0.8	1.1	nd
Beta BHC	nd	nd	nd	nd	nd	nd	4.61	0.03	nd	0.02	nd	nd	nd	nd	nd	nd	nd	nd
Gamma BHC	nd	nd	nd	nd	nd	nd	0.85	0.17	nd	0.09	nd	nd	nd	nd	0.1	nd	nd	nd
4,4'DDE	nd	17.91	nd	106.7	128.2	64.3	4.01	nd	3.68	74.37	nd	1.8	0.5	0.47	3.37	307.2	192.2	38.1
4,4'DDD	nd	0.46	nd	4.6	1.6	1.3	4.99	nd	6.93	3.81	nd	3.8	nd	0.13	2.83	21.8	17.5	8.8
4,4'DDT	nd	0.03	nd	15.1	7.8	nd	5	nd	nd	nd	nd	nd	nd	nd	1.61	44.2	24.8	7.6
Trifluralin	4.8	0.67	nd	nd	nd	nd	nd	nd	0.56	nd	nd	2.44	nd	nd	nd	nd	nd	nd

Table 19. Summary of collecting effort for the upper Yalobusha River Basin (Through May 1997). Mean values are reported with minimum and maximum values in parentheses.

	Headwater	**Riverine**	**Tributary**	**HW & TRIB combined**	**Downstream DJ (Riverine)**	**Upstream DJ (Riverine)**
Site length (m)	147.1 (100-215)	698.3 (640-798)	136 (95-226.4)	137.6 (95-226.4)	672 (640-704)	724.5 (700-798)
Electroshocking effort (min)	16.7 (13.5-19.9)	44.8 (13.6-70)	21.6 (10-57)	21.0 (10-57)	26.8 (13.6-40)	53.8 (40-70)
Hoopnetting effort (net/hrs)	X	284 (144-456)	X	X	240 (144-288)	328 (144-456)

NOTES:

Fish were collected from riverine sites using boat electroshocker and hoopnetting, and from headwater and tributary sites using a backpack electroshocker.

Mean site lengths for riverine sites obtained by Shields may be slightly different than those obtained during fish collecting because of the differences in obtaining site lengths. Shields used a GPS unit to map sites and obtained lengths that will exhibit more accuracy. The current study used a range finder and determined the straight-line distance of a site. This will be more comparable with the site lengths obtained for headwater and tributary sites.

There is uneven sampling effort between sites located downstream and upstream of the debris jam due to both the results of adverse weather conditions and equipment failure. Within sites located downstream of the debris jam: only 2 sites (19 & 20) were sampled with boat electroshocking and 3 sites (20, 21, and 22) were sampled with hoopnets. All 4 sites located above the debris jam were sampled with boat electroshocking (23, 24, 25, and 26), however, only 3 sites were sampled with hoopnets (23, 24, and 25).

Table 20. Fish species collected from the Yalobusha River Basin.

Fish species	Relative abundance (%)
Green sunfish (*Lepomis cyanellus*)	16.60
Smallmouth buffalo (*Ictiobus bubalus*)	11.46
Bluntnose minnow (*Pimephales notatus*)	11.13
Bluegill (*Lepomis macrochirus*)	8.36
Creek chub (*Semotilus atromaculatus*)	6.47
Blacktail shiner (*Cyprinella venusta*)	5.57
Blackspotted topminnow (*Fundulus olivaceus*)	5.09
Gizzard shad (*Dorosoma cepedianum*)	3.42
Creek chubsucker (*Erimyzon oblongus*)	2.85
Redfin shiner (*Lythrurus umbratilis*)	2.69
Striped shiner (*Luxilus chrysocephalus*)	2.67
Emerald shiner (*Notropis atherinoides*)	2.64
Longear sunfish (*Lepomis megalotis*)	1.89
Yazoo shiner (*Notropis rafinesque*)	1.86
Common carp (*Cyprinus carpio*)	1.41
Western mosquitofish (*Gambusia affinis*)	1.28
Bigmouth buffalo (*Ictiobus cyprinellus*)	1.28
Channel catfish (*Ictalurus punctatus*)	1.23
Warmouth (*Lepomis gulosus*)	1.21
Longnose gar (*Lepisosteus osseus*)	1.06
Golden shiner (*Notemigonus crysoleucas*)	0.96
Yellow bullhead (*Ameirus natalis*)	0.86
Brown madtom (*Noturus phaeus*)	0.76
Spotted gar (*Lepisosteus oculatus*)	0.63
Pirate perch (*Aphredoderus sayanus*)	0.60
Bullhead minnow (*Pimephales vigelax*)	0.53
Gulf darter (*Etheostoma swaini*)	0.45
Flathead catfish (*Pylodictus olivaris*)	0.45
Ribbon shiner (*Lythrurus fumeus*)	0.40
Orangefin shiner (*Notropis ammophilus*)	0.40
Orangespotted sunfish (*Lepomis humilus*)	0.33
Black bullhead (*Ameiurus melas*)	0.28
Grass pickerel (*Esox americanus*)	0.28
Johnny darter (*Etheostoma nigrum*)	0.28
Dollar sunfish (*Lepomis marginatus*)	0.25
Black crappie (*Pomoxis nigromaculatus*)	0.20
Redfin darter (*Etheostoma whipplei*)	0.18
Shortnose gar (*Lepisosteus platostomas*)	0.15
Spotted sunfish (*Lepomis punctulatus*)	0.15
Blackside darter (*Percina maculata*)	0.15
White crappie (*Pomoxis annularis*)	0.15
Freshwater drum (*Aplodinotus grunniens*)	0.13
Brook silverside (*Labidesthes sicculus*)	0.13
Spotted bass (*Micropterus punctulatus*)	0.13
White bass (*Morone chrysops*)	0.13
Banded pygmy sunfish (*Elassoma zonatum*)	0.10
Cypress darter (*Etheostoma proeliare*)	0.10
Redear sunfish (*Lepomis microlophus*)	0.10
Tadpole madtom (*Noturus gyrinus*)	0.08
Pugnose minnow (*Opsopoeodus emiliae*)	0.08
Bluntnose darter (*Etheostoma chlorosomum*)	0.05
Speckled darter (*Etheostoma stigmaeum*)	0.05
Blue catfish (*Ictalurus furcatus*)	0.05
Spotted sucker (*Minytrema melanops*)	0.05
Brindled madtom (*Noturus miurus*)	0.05
Bowfin (*Amia calva*)	0.03
River carpsucker (*Carpoides carpio*)	0.03
Cypress minnow (*Hybognathus hayi*)	0.03
Mississippi silvery minnow (*Hybognathus nuchalis*)	0.03
Least brook lamprey (*Lampetra aepyptera*)	0.03
Ghost shiner (*Notropis buchanani*)	0.03
Sunfish species (*Lepomis* species)	0.03

Table 21. List of species previously unreported for the Yalobusha River Basin.

Bowfin	Bigmouth buffalo	White bass
Black bullhead	Blue catfish	Orangefin shiner
Yellow bullhead	Channel catfish	Tadpole madtom
Freshwater drum	Brook silverside	Brindled madtom
River carpsucker	Dollar sunfish	Pugnose minnow
Gizzard shad	Redear sunfish	White crappie
Grass pickerel	Spotted gar	Black crappie
Gulf darter	Longnose gar	Flathead catfish
Cypress minnow	Shortnose gar	
Smallmouth buffalo	Spotted sunfish	

Table 22. Total species richness, mean species richness, total number of captures, and mean number of captures for the upper Yalobusha River Basin.

	Headwater	**Riverine**	**Tributary**
Total species richness	20	35	46
Mean species richness	12.67	12.88	11.68
Total number of captures	149	1022	2800
Mean number of captures	49.67	127.75	127.18

Table 23. Species composition for each Site category (headwater, riverine, and tributary).

Fish species	Relative abundance (%) Headwater	Relative abundance (%) Riverine	Relative abundance (%) Tributary
Green sunfish	22.15	0.29	22.25
Bluegill	16.78	2.84	9.93
Blacktail shiner	6.71	9.10	4.21
Creek chubsucker	6.71	0.00	3.68
Warmouth	6.71	0.20	1.29
Blackspotted topminnow	6.04	0.10	6.86
Western mosquitofish	6.04	0.20	1.43
Redfin shiner	6.04	5.09	1.64
Grass pickerel	4.03	0.29	0.07
Dollar sunfish	4.03	0.00	0.14
Spotted sunfish	4.03	0.00	0.00
Bluntnose minnow	2.68	0.10	15.61
Pirate perch	1.34	0.00	0.79
Banded pygmy sunfish	1.34	0.00	0.07
Golden shiner	1.34	0.00	1.29
Pugnose minnow	1.34	0.10	0.00
Longear sunfish	0.67	0.00	2.64
Striped shiner	0.67	0.00	3.75
Spotted bass	0.67	0.10	0.11
Creek chub	0.67	0.00	9.14
Bowfin	0.00	0.10	0.00
Black bullhead	0.00	0.00	0.39
Yellow bullhead	0.00	0.29	1.11
Freshwater drum	0.00	0.49	0.00
River carpsucker	0.00	0.00	0.04
Common carp	0.00	5.48	0.00
Gizzard shad	0.00	3.62	3.54
Bluntnose darter	0.00	0.00	0.07
Johnny darter	0.00	0.00	0.39
Cypress darter	0.00	0.00	0.14
Speckled darter	0.00	0.00	0.07
Gulf darter	0.00	0.00	0.64
Redfin darter	0.00	0.00	0.25
Cypress minnow	0.00	0.00	0.04
Mississippi silvery minnow	0.00	0.00	0.04
Smallmouth buffalo	0.00	44.52	0.00
Bigmouth buffalo	0.00	4.99	0.00
Blue catfish	0.00	0.20	0.00
Channel catfish	0.00	4.40	0.14
Least brook lamprey	0.00	0.00	0.04
Brook silverside	0.00	0.49	0.00
Spotted gar	0.00	2.45	0.00
Longnose gar	0.00	4.11	0.00
Shortnose gar	0.00	0.59	0.00
Orangespotted sunfish	0.00	0.39	0.32
Redear sunfish	0.00	0.29	0.04
Ribbon shiner	0.00	1.17	0.14
Spotted sucker	0.00	0.10	0.04
White bass	0.00	0.49	0.00
Orangefin shiner	0.00	0.00	0.57
Emerald shiner	0.00	4.21	2.21
Ghost shiner	0.00	0.10	0.00
Tadpole madtom	0.00	0.00	0.11
Brindled madtom	0.00	0.00	0.07
Brown madtom	0.00	0.00	1.07
Yazoo shiner	0.00	0.00	2.64
Blackside darter	0.00	0.00	0.21
Bullhead minnow	0.00	0.49	0.57
White crappie	0.00	0.49	0.04
Black crappie	0.00	0.29	0.18
Flathead catfish	0.00	1.76	0.00
Sunfish species	0.00	0.10	0.00

Table 24. Total species richness, mean species richness, total number of captures and mean number of captures for riverine sites located upstream and downstream of the debris jam.

	Downstream	Upstream
Total species richness	17	31
Mean species richness	8.75	17.0
Total number of captures	521	501
Mean number of captures	130.25	125.25

Table 25. Species composition of sites located upstream and downstream of the debris jam.

Species	Downstream – Relative abundance (%)	Upstream – Relative abundance (%)
Smallmouth buffalo	80.6	7.0
Emerald shiner	4.8	3.6
Common carp	3.5	7.6
Flathead catfish	2.5	1.0
Channel catfish	1.5	7.4
Spotted gar	1.2	3.8
Shortnose gar	1.2	0.0
White bass	1.0	0.0
Gizzard shad	0.8	6.6
Freshwater drum	0.6	0.4
Blacktail shiner	0.6	18.0
Longnose gar	0.6	7.8
Bigmouth buffalo	0.4	9.8
Black crappie	0.4	0.2
Blackspotted topminnow	0.2	0.0
Spotted bass	0.2	0.0
White crappie	0.2	0.8
Bowfin	0.0	0.2
Yellow bullhead	0.0	0.6
Grass pickerel	0.0	0.6
Western mosquitofish	0.0	0.4
Blue catfish	0.0	0.4
Brook silverside	0.0	1.0
Green sunfish	0.0	0.6
Warmouth	0.0	0.4
Orangespotted sunfish	0.0	0.8
Bluegill	0.0	5.8
Redear sunfish	0.0	0.6
Ribbon shiner	0.0	2.4
Redfin shiner	0.0	10.4
Spotted sucker	0.0	0.2
Ghost shiner	0.0	0.2
Pugnose shiner	0.0	0.2
Bluntnose minnow	0.0	0.2
Bullhead minnow	0.0	1.0

Table 26. Summary of habitat data collected for nine invertebrate sites.

STATION #	F03	F07	F15	F16	F27	F31	F32	F33	F172
LATITUDE	33.50086	33.464	33.52426	33.54992	33.51757	33.5395	33.46372	33.57463	33.44678
LONGITUDE	-89.35925	-89.23341	-89.26025	-89.15812	-89.0634	-89.13091	-89.23327	-89.10589	-89.09059
AIR TEMP (degrees C)	16.4	17.5	22.8	20.3	22.5	23.1	18.8	24.2	
CHANNEL WIDTH (meters)	11	4.75	5.5	6	6.5	12	5.25	4.5	23
CHANNEL DEPTH (meters)	3	2.5	2.5	5.5	1.25	5	4	2.7	6
STREAM WIDTH (meters)	6	2	2.75	2.5	2	3.5	1.75	2.25	6.5
STREAM DEPTH (meters)	0.12	0.1	0.1	0.12	0.7	0.12	0.35	0.15	0.25
VELOCITY (meters/second)	0.3	0.1	0.25	0.4	0.5	0.33	0.3	0.3	1
REACH LENGTH (meters)	50	50	50	50	50	50	50	50	100
HIGH WATER MARK (meters)	3	1.5	2.5	2.5	1.25	3	3	2.5	2.75
CANOPY *	PS	PS	NO	PS	CS	PS	CS	PS	PS
% AQUATIC VEGETATION	0	5	0	0	45	0	1	0	1
SUM LWD WIDTHS	12	5.5	6	16	0	1	0	1	0
SUM LWD LENGTHS	11	10	5.5	17	0	1.5	0	1.5	0
WATER TEMP (degrees C)	7.9	7.7	9.7	11.7	11.5	14.7	11.4	9.9	8.4
CONDUCTANCE (umhos/cm)	54	87	49	46	101	71	64	188	255
DISSOLVED OXYGEN (mg/L)	11.7	10.9	12.1	11.2	12.8	12.3	10.7	10.8	12.3
PH	6.35	5.58	6.43	7.75	5.6	6.04	6.97	6.1	5.2
SUBSTRATE CHARACTERIZATION									
%BEDROCK OR HARDPAN CLAY	0	45	71	0	0	95	86	48	57
%BOULDER	0	1	0	0	0	1	0	0	2
%COBBLE	0	1	0	0	0	1	3	0	25
%GRAVEL	1	6	2	3	0	2	3	40	10
%SAND	99	45	25	93	0	1	6	2	4
%SILT	0	2	2	1	50	0	2	0	2
%CLAY	0	0	0	3	50	0	0	0	0
OVERLAY MATERIAL									
%DETRITUS	8	6	2	8	3	1	4	1	1
%MUCK-MUD	0	3	0	0	0	0	0	0	0
%MARL	0	0	0	0	0	0	0	0	0
MICROHABITAT CHARACTERIZATION									
%RIFFLES	0	10	5	1	0	0	0	0	15
%POOLS	20	30	5	8	0	5	5	5	5
%RUNS	50	35	80	74	55	95	89	90	70
%SNAGS	10	10	5	12	0	0	0	2	0
%DETRITUS/ROOTS	20	10	5	5	0	0	5	3	5
%SUBM. MACROPHYTES	0	5	0	0	0	0	0	0	0
%EMERG. MACROPHYTES	0	0	0	0	45	0	1	0	5
%OTHER	0	0	0	0	0	0	0	0	0
EPA-RBP HABITAT METRIC SCORE SHEET									
HABITAT SCORE #1	4	18	8	15	2	2	2	5	9
HABITAT SCORE #2	8	12	7	13	7	0	8	9	11
HABITAT SCORE #3	8	9	7	6	3	1	8	3	8
HABITAT SCORE #4	1	11	9	9	0	18	8	10	14
HABITAT SCORE #5	7	5	9	8	6	9	6	8	10
HABITAT SCORE #6	6	13	8	14	1	14	3	5	14
HABITAT SCORE #7	6	13	8	5	1	8	3	4	9
HABITAT SCORE #8	8	14	4	12	2	14	4	4	13
HABITAT SCORE #9	2	16	4	10	6	16	10	6	12
HABITAT SCORE #10	18	20	6	20	0	2	0	4	3
TOTAL HABITAT SCORE	68	131	70	111	28	84	52	58	103

* (PS=partly shaded, NO=none, CS=completely shaded)

Table 27. List of aquatic invertebrates collected from Site F172 using EPA's Rapid Bioassessment Protocol.

Order	Family	Genus/species	Count
Amphipoda	Crangonyctidae	*Crangonyx*	11
Annelida	Lumbriculidae	*Lumbriculus*	1
Coleoptera	Hydrophilidae	*Berosus*	1
Diptera	Chironomidae	unknown	28
	Simuliidae	*Prosimulium*	12
	Tipulidae	*Tipula*	5
Plecoptera	unknown	unknown	1
Trichoptera	Hydropsychidae	*Cheumatopsyche*	2
		Total	61

Table 28. List of aquatic invertebrates collected from Site F27 using EPA's Rapid Bioassessment Protocol.

Order	Family	Genus/species	Count
Amphipoda	Crangonyctidae	*Crangonyx*	1
Annelida	Annelida	unknown	3
Decapoda	Astacidae	unknown	5
Diptera	Chironomidae	unknown	72
	Simuliidae	*Prosimulium*	10
		Simulium	20
	Tipulidae	*Tipula*	6
Gastropoda	Physidae	*Physella*	3
Pelecypoda	unknown	unknown	2
Plecoptera	unknown	unknown	1
Trichoptera	Limnephilidae	unknown	1
	Phryganeidae	*Ptilostomis*	1
		Total	125

Table 29. List of aquatic invertebrates collected from Site F32 using EPA's Rapid Bioassessment Protocol.

Order	Family	Genus/species	Count
Annelida	Annelida	unknown	5
Amphipoda	Crangonyctidae	*Crangonyx*	16
Coleoptera	Elmidae	*Stenelmis*	3
Decapoda	Astacidae	unknown	1
Diptera	Chironomidae	unknown	5
	Simuliidae	*Prosimulium*	14
		Simulium	42
	Tipulidae	*Tipula*	1
	Tabanidae	*Chrysops*	1
Ephemeroptera	Caenidae	*Caenis*	13
Isopoda	Asellidae	*Lirceus*	3
Pelecypoda	Sphaeriidae	unknown	1
Plecoptera	Taeniopterygidae	*Strophopteryx*	4
		Total	109

Table 30. List of aquatic invertebrates collected from Site F31 using EPA's Rapid Bioassessment Protocol.

Order	Family	Genus/species	Count
Coleoptera	Hydrophilidae	*Berosus*	2
Diptera	Chironomidae	unknown	57
	Simuliidae	*Simulium*	3
Ephemeroptera	Caenidae	*Caenis*	4
	Heptageniidae	*Stenonema*	31
Megaloptera	Corydalidae	*Corydalus*	1
Odonata	Gomphidae	*Progomphus*	5
Pelecypoda	unknown	unknown	3
Plecoptera	Capniidae	*Allocapnia*	1
Trichoptera	Hydropsychidae	*Cheumatopsyche*	2
		Total	109

Table 31. List of aquatic invertebrates collected from Site F16 using EPA's Rapid Bioassessment Protocol.

Order	Family	Genus/species	Count
Amphipoda	Crangonyctidae	*Crangonyx*	5
Decapoda	Astacidae	unknown	3
Diptera	Chironomidae	unknown	5
	Simuliidae	*Prosimulium*	22
		Simulium	14
	Tipulidae	*Tipula*	9
		other, unknown	1
Ephemeroptera	Baetidae	*Baetis*	1
	Caenidae	*Caenis*	2
	Heptageniidae	*Stenonema*	129
	Leptophlebiidae	*Leptophlebia*	1
Isopoda	Asellidae	*Caecidotea*	1
		Lirceus	1
Odonata	Aeschnidae	*Boyeria*	1
	Calopterygidae	*Calopteryx*	11
	Gomphidae	*Gomphus*	1
		Progomphus	24
Plecoptera	Perlodidae	*Clioperia*	1
		Isoperla	3
Trichoptera	Limnephilidae	*Pycnopsyche*	7
		Total	242

Table 32. List of aquatic invertebrates collected from Site F33 using EPA's Rapid Bioassessment Protocol.

Order	Family	Genus/species	Count
Amphipoda	Crangonyctidae	*Crangonyx*	8
Diptera	Chironomidae	unknown	9
	Simuliidae	*Prosimulium*	1
	Tipulidae	*Tipula*	5
		other, unknown	1
Ephemeroptera	Caenidae	*Caenis*	5
Odonata	Calopterygidae	*Calopteryx*	1
	Gomphidae	*Progomphus*	1
Plecoptera	Capniidae	*Allocapnia*	7
Trichoptera	Rhyacophilidae	*Rhyacophila*	1
	Limnephilidae	*Ironoquia*	1
		Total	40

Table 33. List of aquatic invertebrates collected from Site F3 using EPA's Rapid Bioassessment Protocol.

Order	Family	Genus/species	Count
Amphipoda	Crangonyctidae	*Crangonyx*	1
Coleoptera	Gyrinidae	*Dineutus*	3
Diptera	Simuliidae	*Prosimulium*	5
Ephemeroptera	Baetidae	*Baetis*	2
	Baetiscidae	*Baetisca*	1
	Caenidae	*Caenis*	2
	Heptageniidae	*Stenonema*	2
Odonata	Gomphidae	*Progomphus*	9
Plecoptera	Capniidae	*Allocapnia*	5
	Nemouridae	*Amphinemura*	2
	unknown	unknown	1
Trichoptera	Limnephilidae	unknown	1
		Total	34

Table 34. List of aquatic invertebrates collected from Site F7 using EPA's Rapid Bioassessment Protocol.

Order	Family	Genus/species	Count
Amphipoda	Crangonyctidae	*Crangonyx*	3
Annelida	Annelida	unknown	1
	Lumbriculidae	*Lumbriculus*	5
Coleoptera	Dryopidae	*Helichus*	1
Decapoda	Astacidae	unknown	1
Diptera	Chironomidae	unknown	4
	Simuliidae	*Prosimulium*	6
	Tabanidae	*Tabanus*	1
	Tipulidae	*Limonia*	2
		Tipula	2
Ephemeroptera	Ephemerellidae	*Hexagenia*	1
	Heptageniidae	*Stenonema*	1
	Caenidae	*Caenis*	9
Odonata	Calopterygidae	*Calopteryx*	9
Pelecypoda	unknown	unknown	1
Plecoptera	Capniidae	*Allocapnia*	1
Trichoptera	Hydropsychidae	*Cheumatopsyche*	3
	Limnephilidae	*Pycnopsyche*	1
		Total	52

Table 35. List of aquatic invertebrates collected from Site F15 using EPA's Rapid Bioassessment Protocol.

Order	Family	Genus/species	Count
Annelida	Annelida	unknown	6
Diptera	Chironomidae	unknown	48
	Simuliidae	*Prosimulium*	514
		Simulium	137
	Tabanidae	unknown	2
	Tipulidae	*Tipula*	1
Ephemeroptera	Baetidae	*Baetis*	2
	Baetiscidae	*Baetisca*	9
	Caenidae	*Caenis*	2
	Capniidae	*Allocapnia*	1
	Heptaneniidae	*Stenonema*	5
	Taeniopterygidae	*Taeniopteryx*	1
Gastropoda	Lymnaeidae	*Lymnaea*	2
Pelecypoda	unknown	unknown	1
Plecoptera	Perlodidae	*Isoperla*	1
Trichoptera	Polycentropodidae	*Cyrnellus*	3
		Total	735